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Kitamura et al.

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(45) **Date of Patent: Sep. 25, 2018**

(54) **IMAGE FORMING APPARATUS USING DETECTION FEEDBACK TO CONTROL BELT MOVEMENT**

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(73) Assignee: **Oki Data Corporation**, Tokyo (JP)

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(22) Filed: **Jan. 20, 2017**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G03G 15/00 (2006.01)
G03G 15/16 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/161*** (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/161
USPC 399/71
See application file for complete search history.

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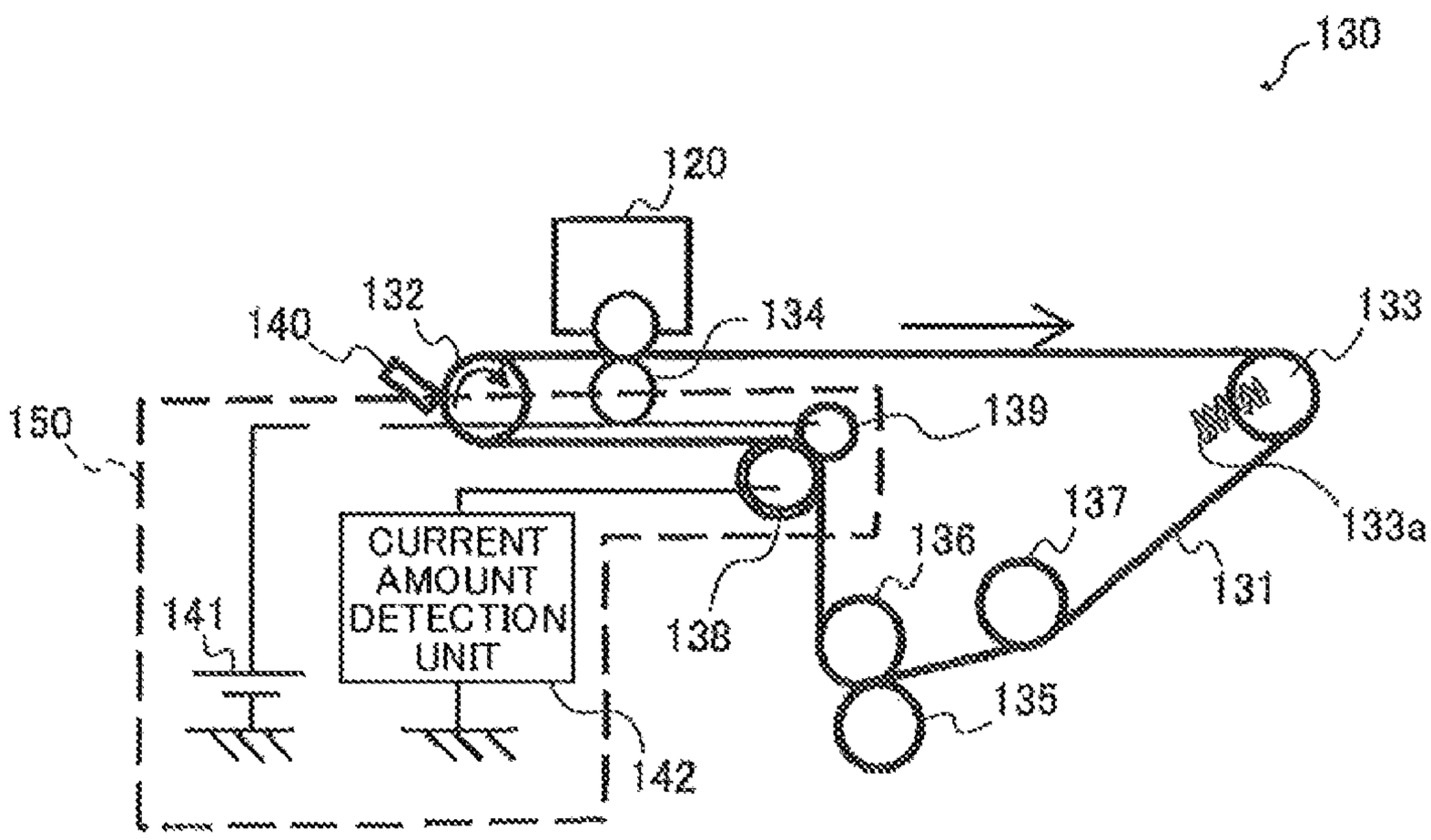
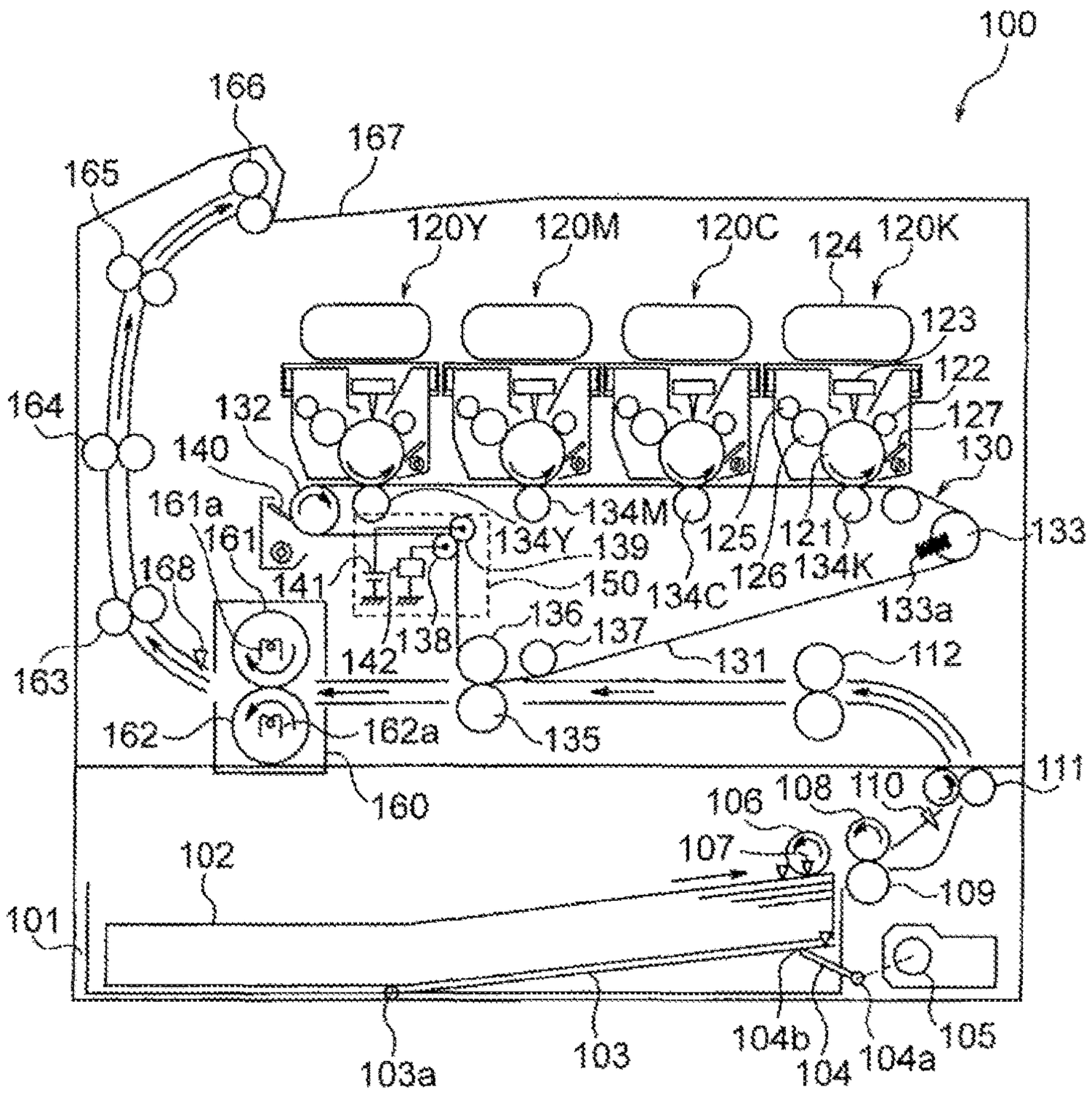
Primary Examiner — Quana M Grainger
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

An image forming apparatus includes a movable endless belt, an image forming unit forming a developer image, a transfer unit transferring the developer image to a medium on a downstream side of the image forming unit in a belt moving direction, a belt cleaning unit cleaning the belt on a downstream side of the transfer unit in the belt moving direction, a detection unit detecting a surface state of the belt on a downstream side of the transfer unit and on an upstream side of the belt cleaning unit in the belt moving direction, and a control unit stopping move of the belt based on a result detected at the detection unit before any foreign object on the belt reaches the belt cleaning unit or the image forming unit.

15 Claims, 19 Drawing Sheets

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125
121
133
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134C
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134K
133a
136
137
138
142
131
112
163
162
162a
135
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106
108
110
107
109
102
101
103a
103
104b
104
104a
105

Fig. 1

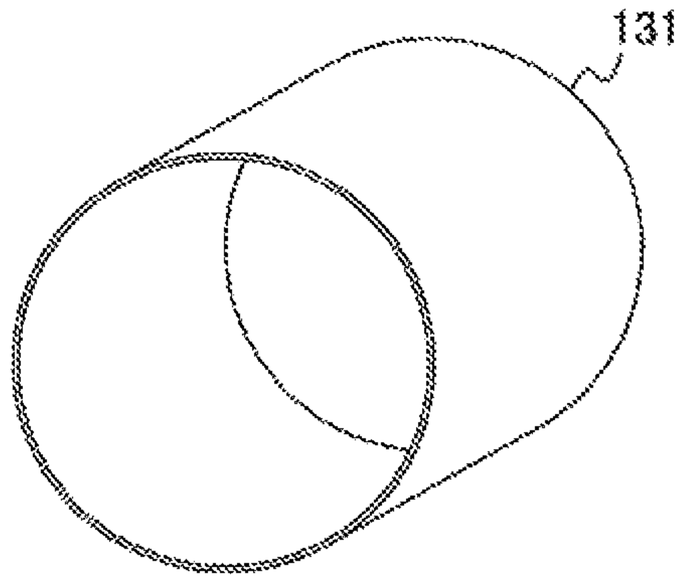
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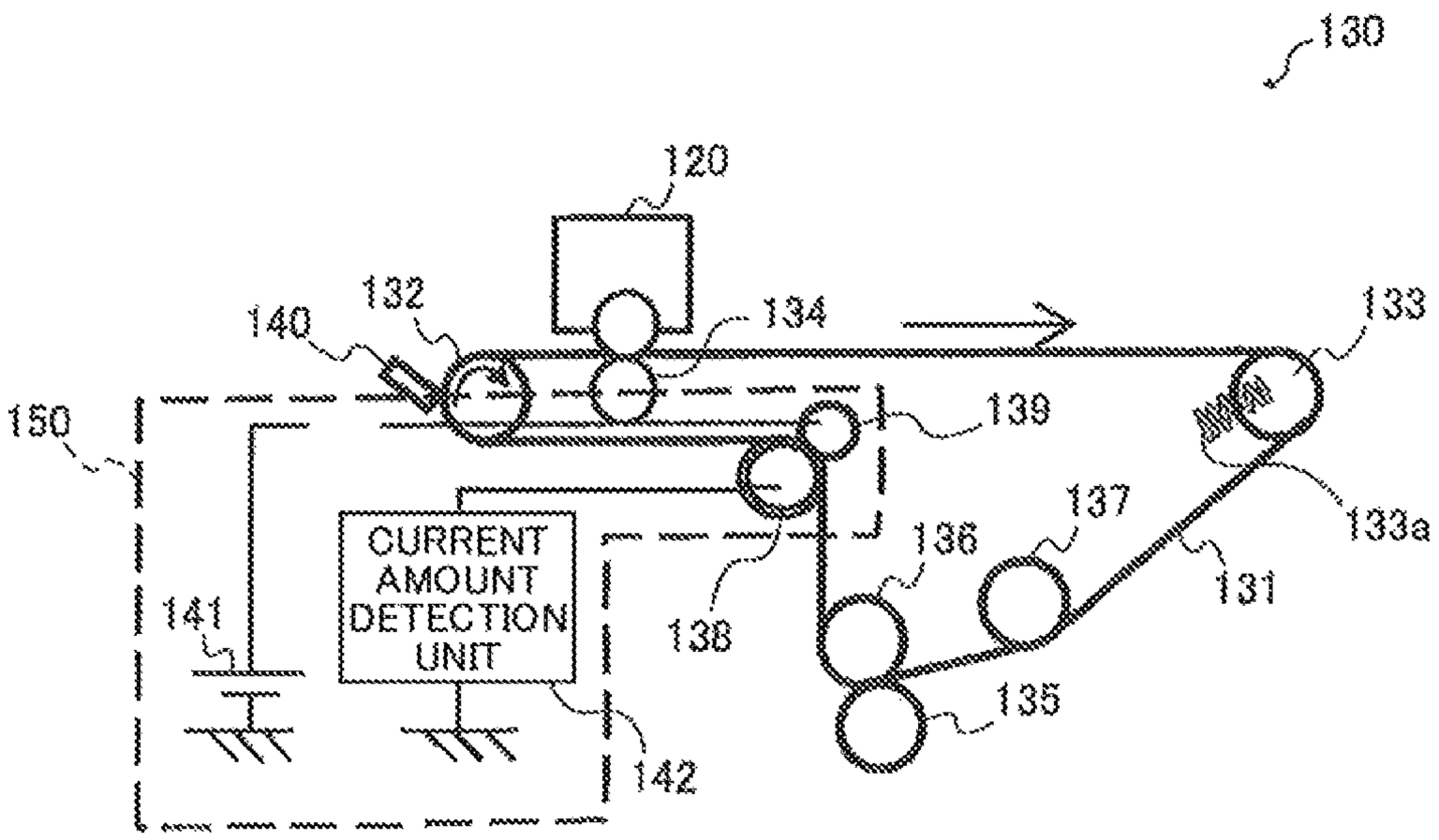
Fig.2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133a
136
131
CURRENT AMOUNT DETECTION UNIT
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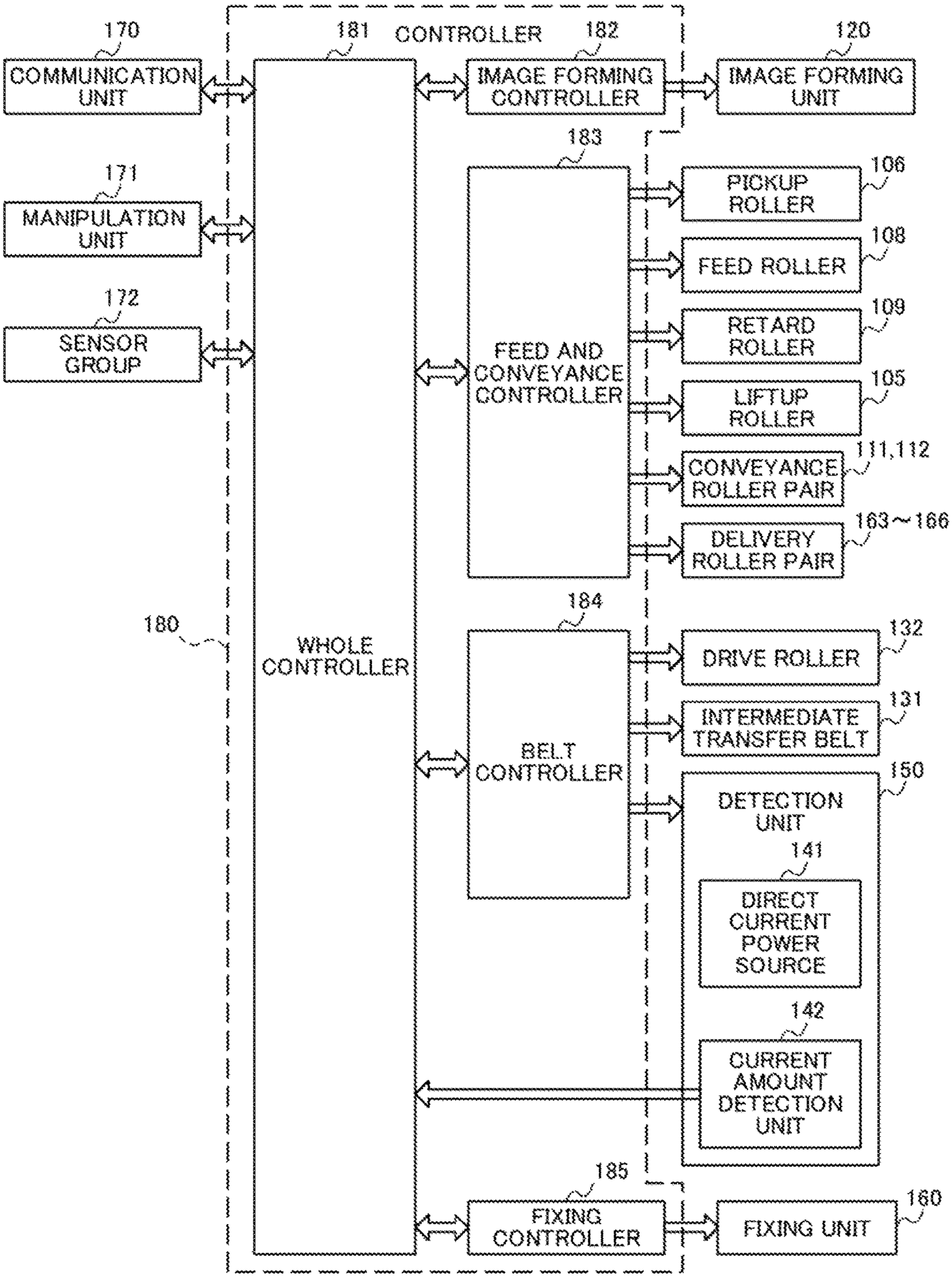
138
135
142

Fig.3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WHOLE CONTROLLER
181 CONTROLLER
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IMAGE FORMING UNIT
183
FEED AND CONVEYANCE CONTROLLER
106
PICKUP ROLLER
108
FEED ROLLER
109
RETARD ROLLER
105
LIFTUP ROLLER
111,112
CONVEYANCE ROLLER PAIR
163～166
DELIVERY ROLLER PAIR
184
BELT CONTROLLER
132
DRIVE ROLLER
131
INTERMEDIATE TRANSFER BELT
150
DETECTION UNIT
141
DIRECT CURRENT POWER SOURCE
142
CURRENT AMOUNT DETECTION UNIT
185
FIXING CONTROLLER
160
FIXING UNIT

Fig.4

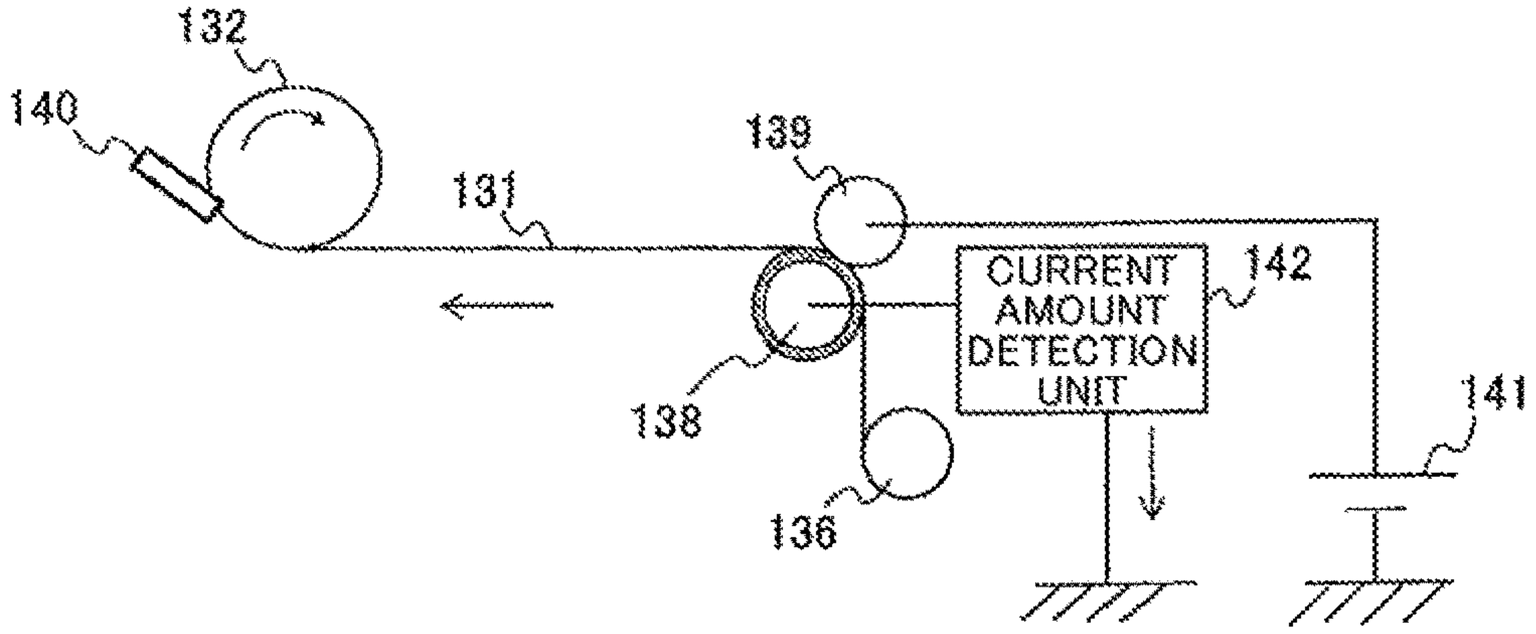
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Fig.5A

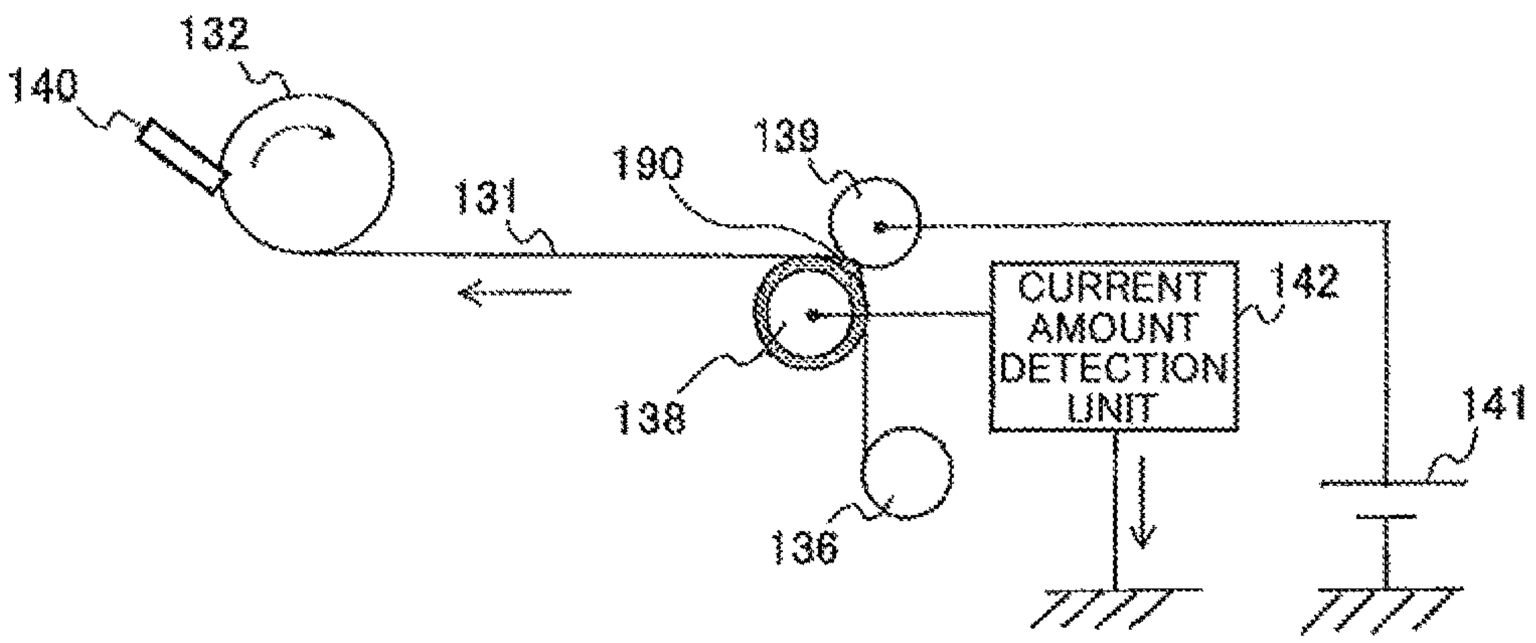
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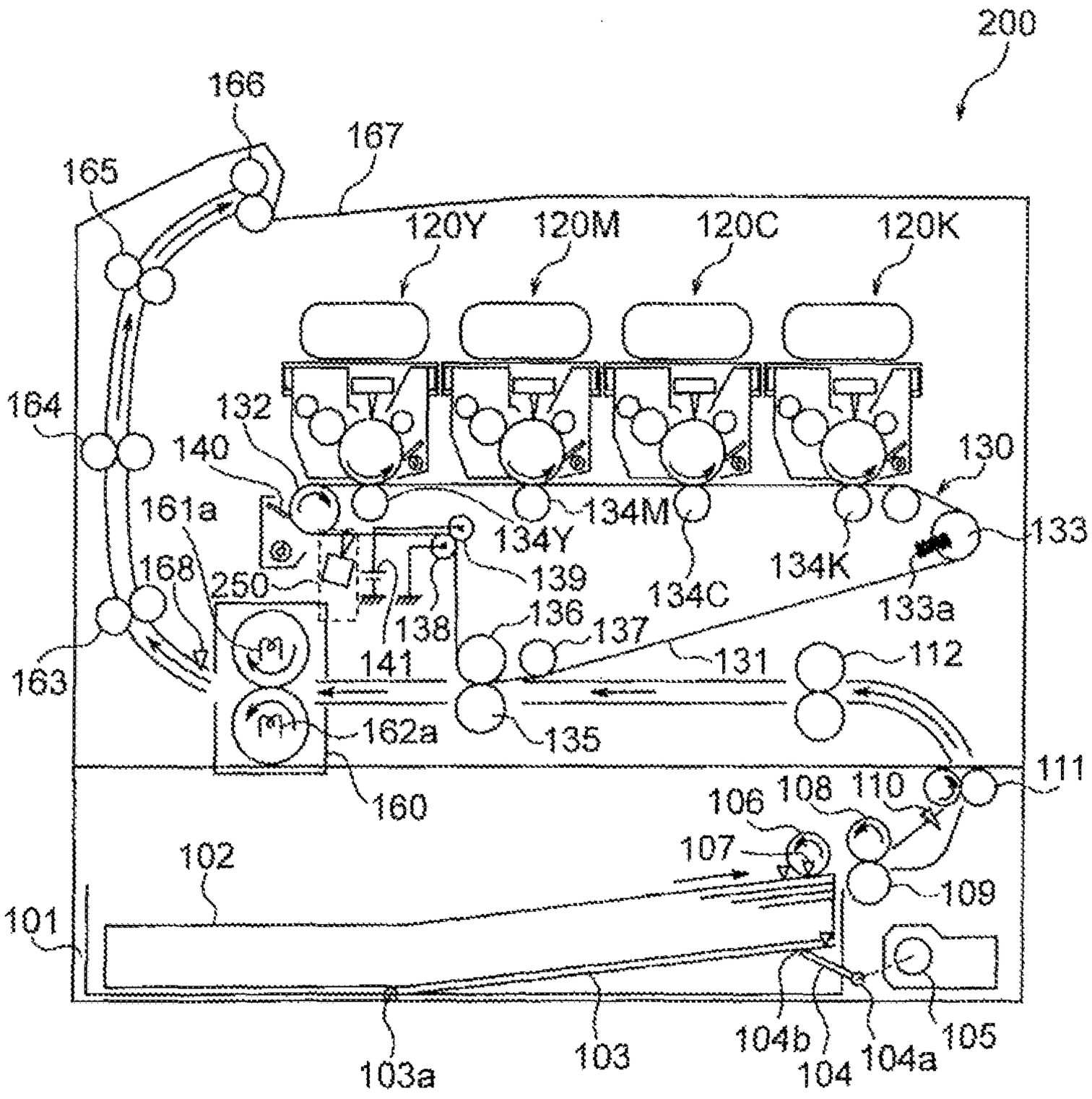
Fig.5B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134C
133a
136
137
138
141
131
112
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162a
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111
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106
108
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102
107
109
101
104b
105
103a
103
104
104a

Fig.6

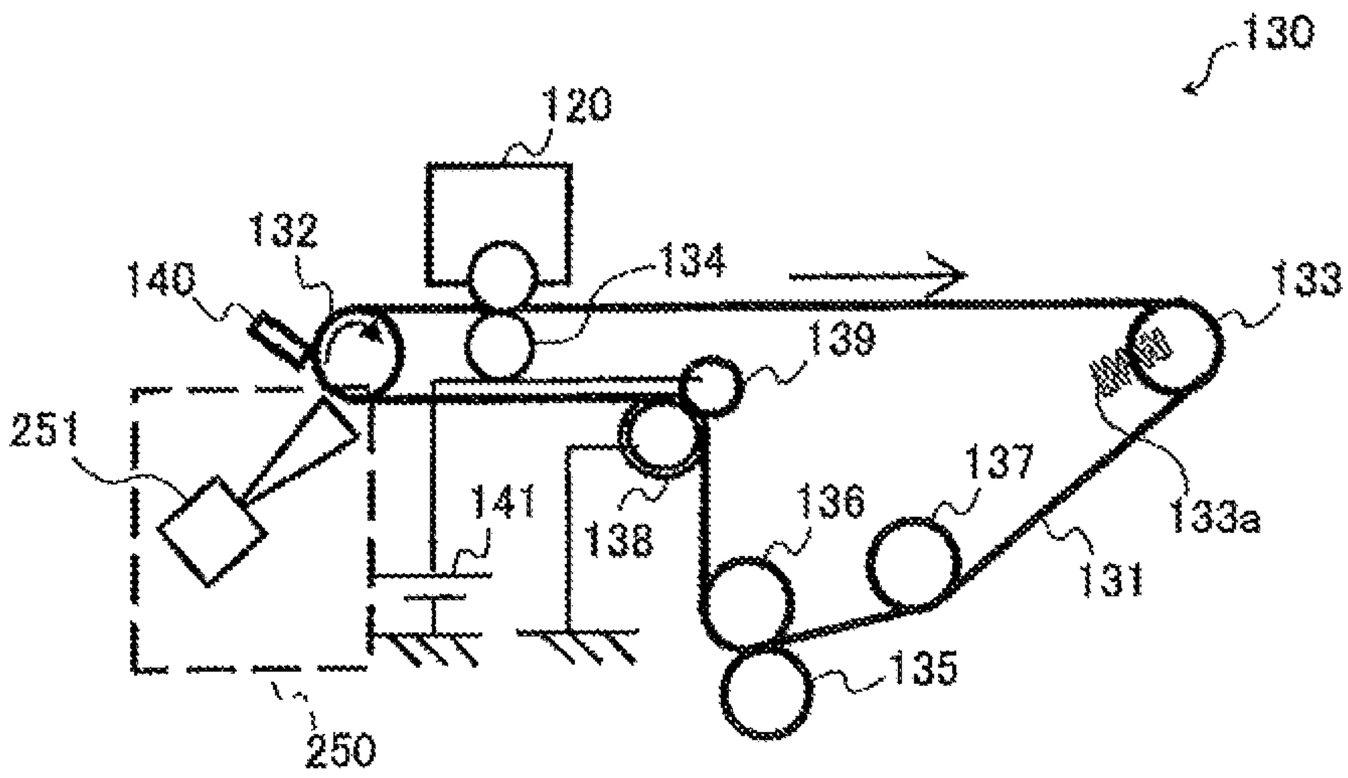

Fig.7

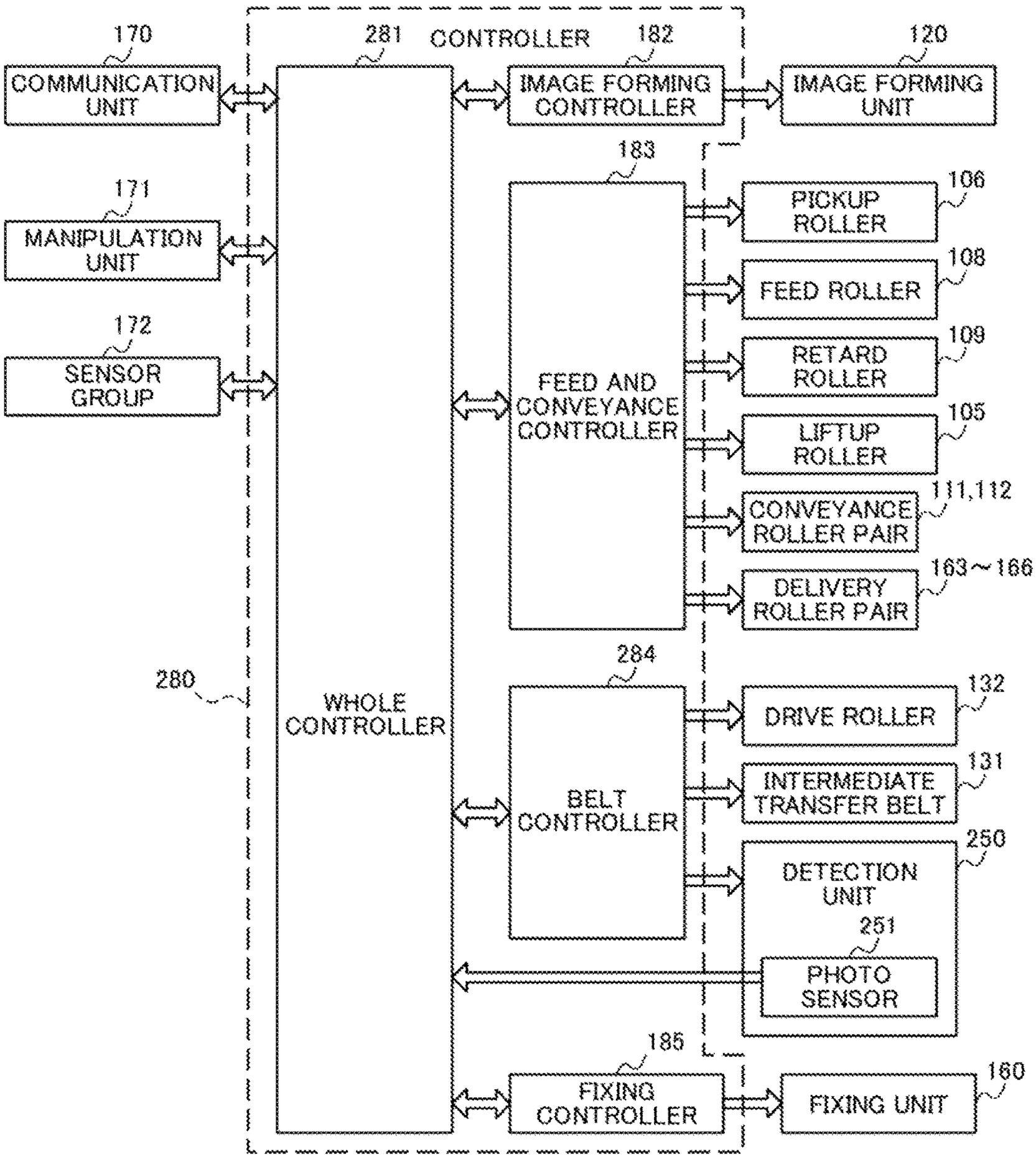
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IMAGE FORMING UNIT
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FEED AND CONVEYANCE CONTROLLER
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PICKUP ROLLER
108
FEED ROLLER
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RETARD ROLLER
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LIFTUP ROLLER
111,112
CONVEYANCE ROLLER PAIR
163～166
DELIVERY ROLLER PAIR
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BELT CONTROLLER
132
DRIVE ROLLER
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INTERMEDIATE TRANSFER BELT
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DETECTION UNIT
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PHOTO SENSOR
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FIXING CONTROLLER
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FIXING UNIT

Fig.8

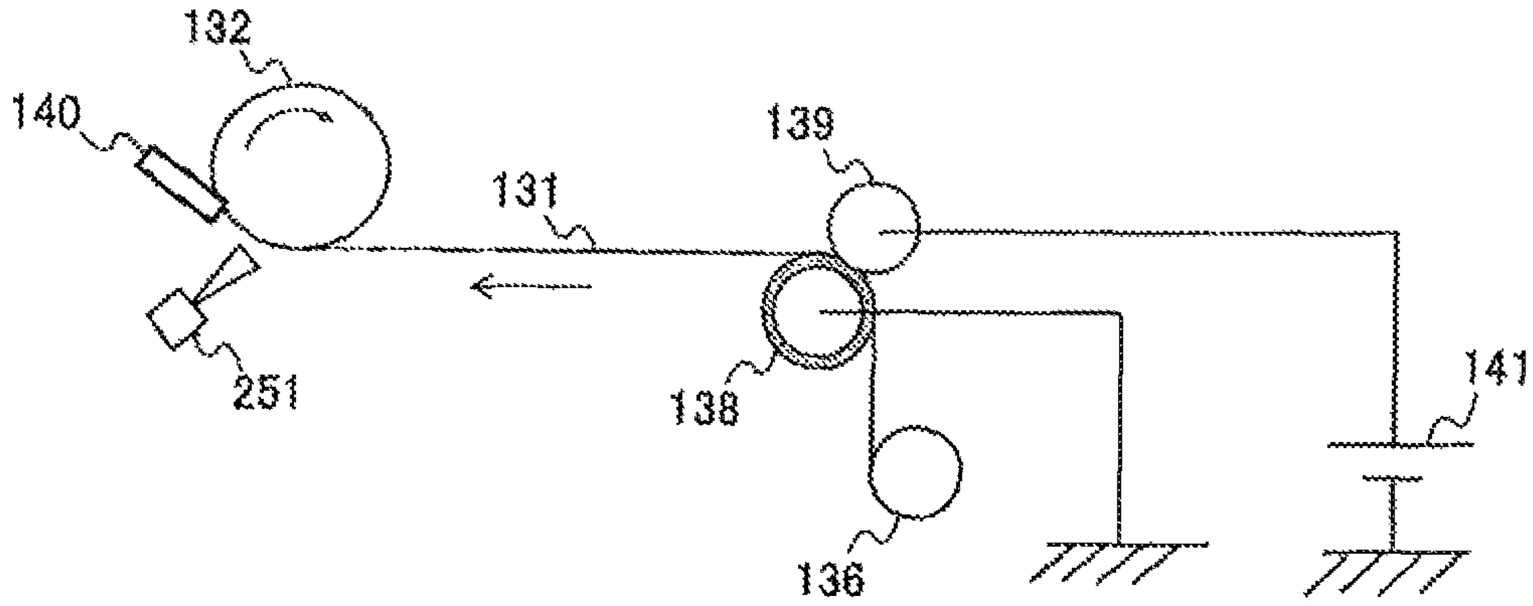
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Fig.9A

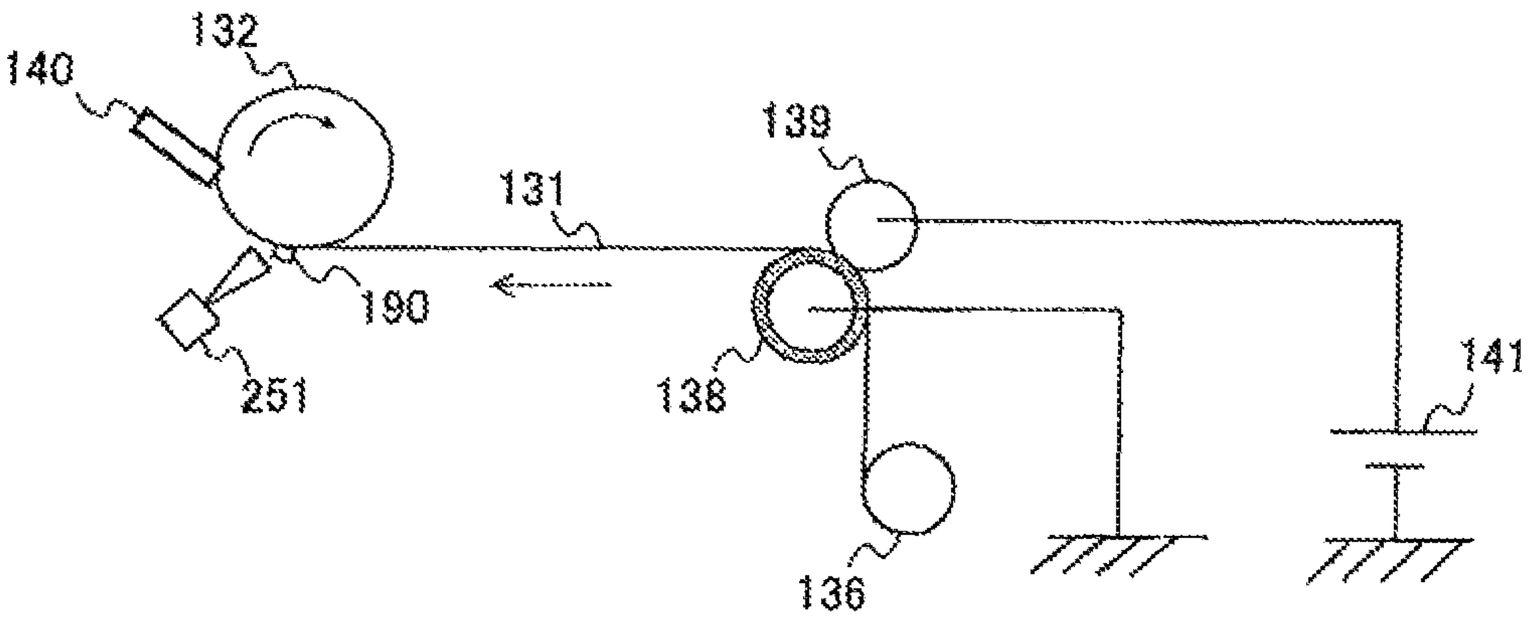
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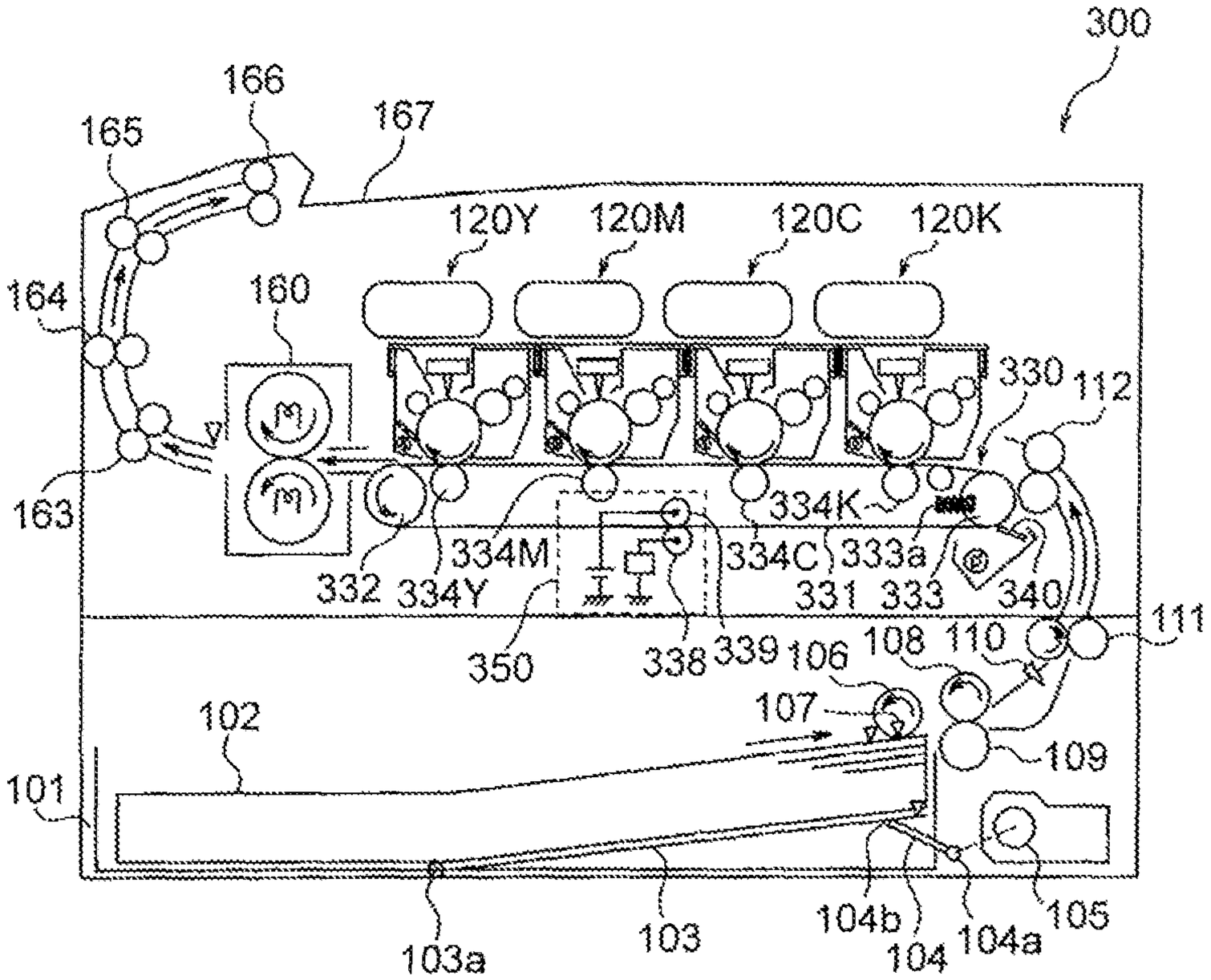
Fig.9B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103a
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104a
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Fig.10

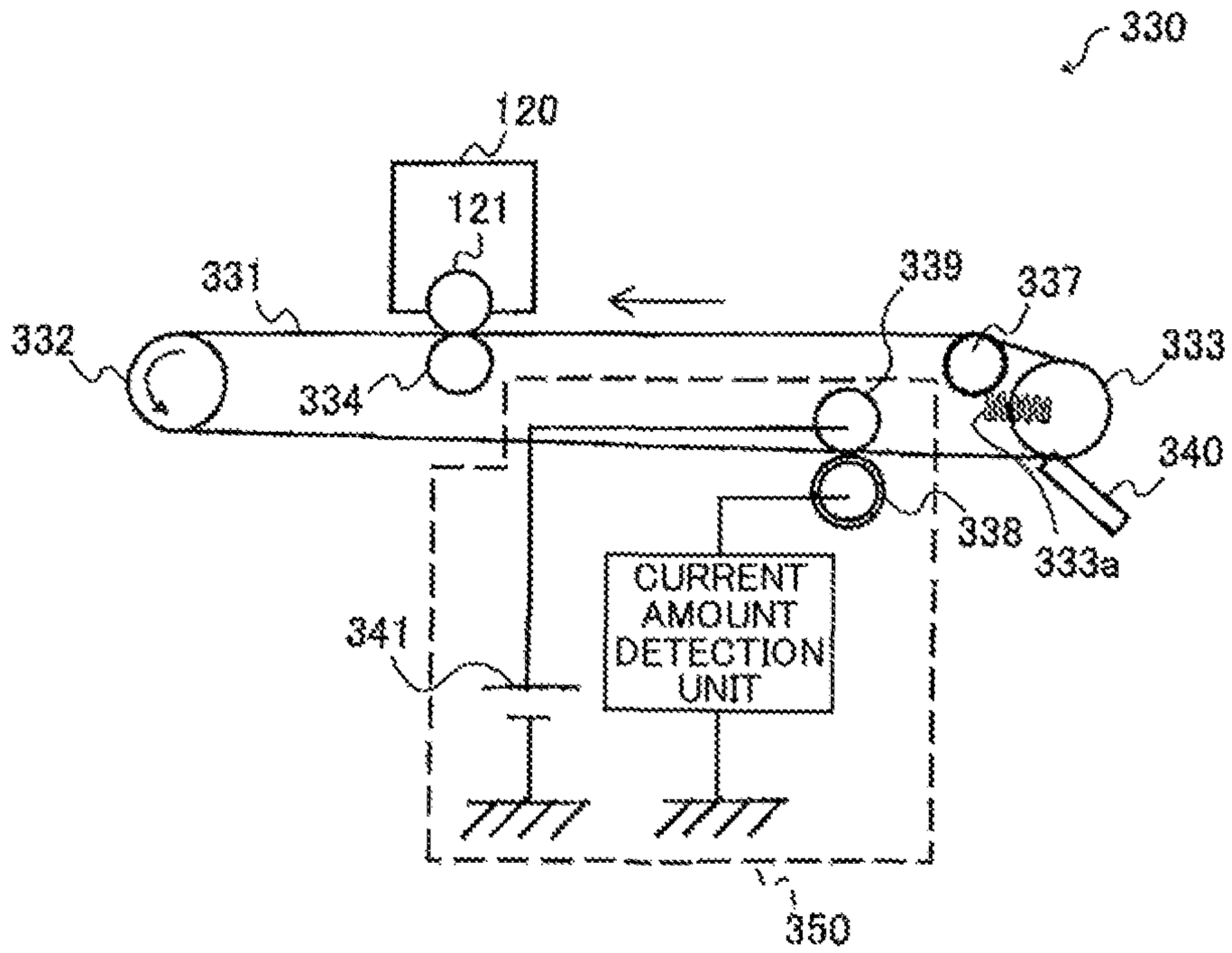
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Fig.11

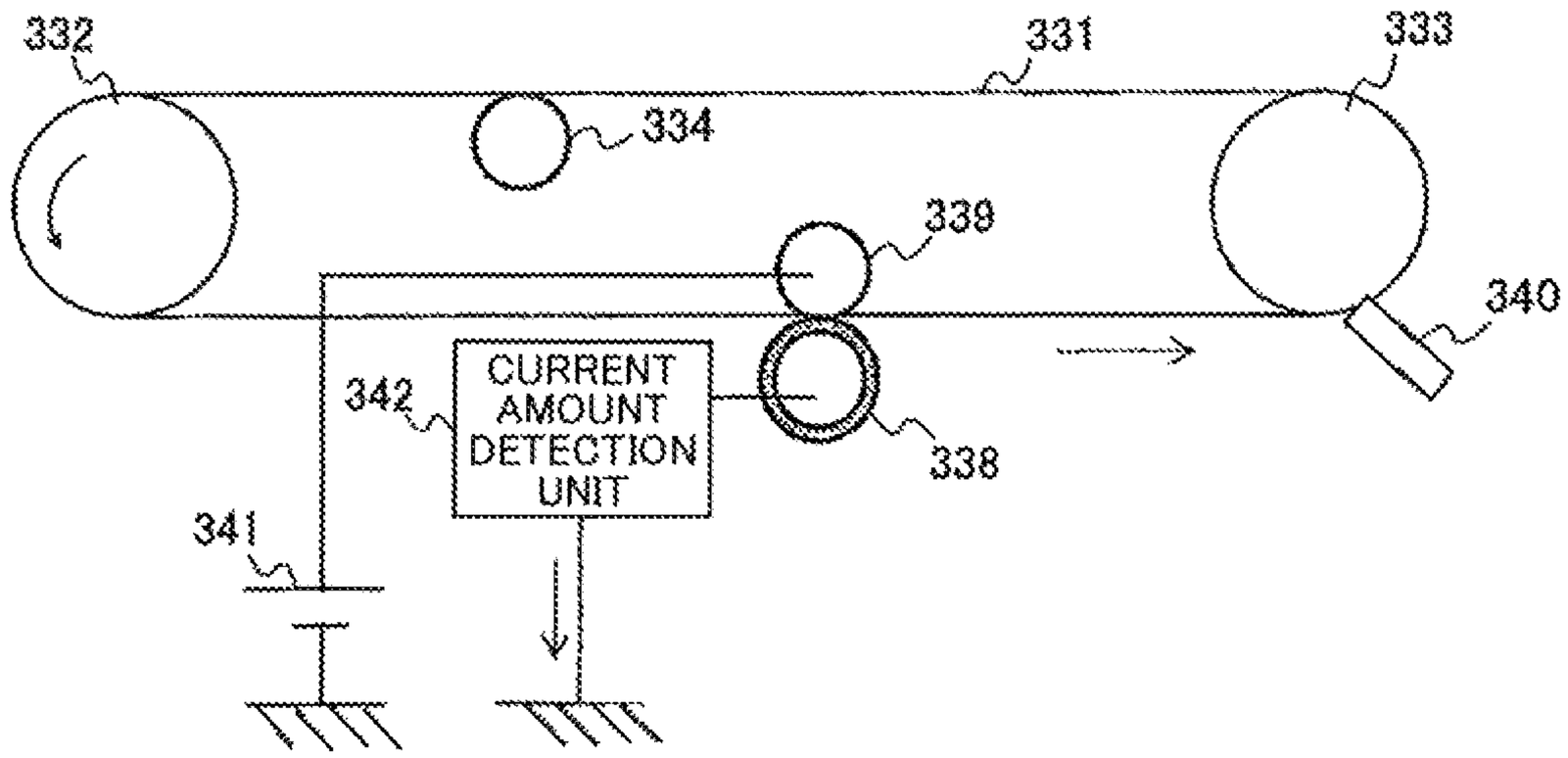

Fig.12A

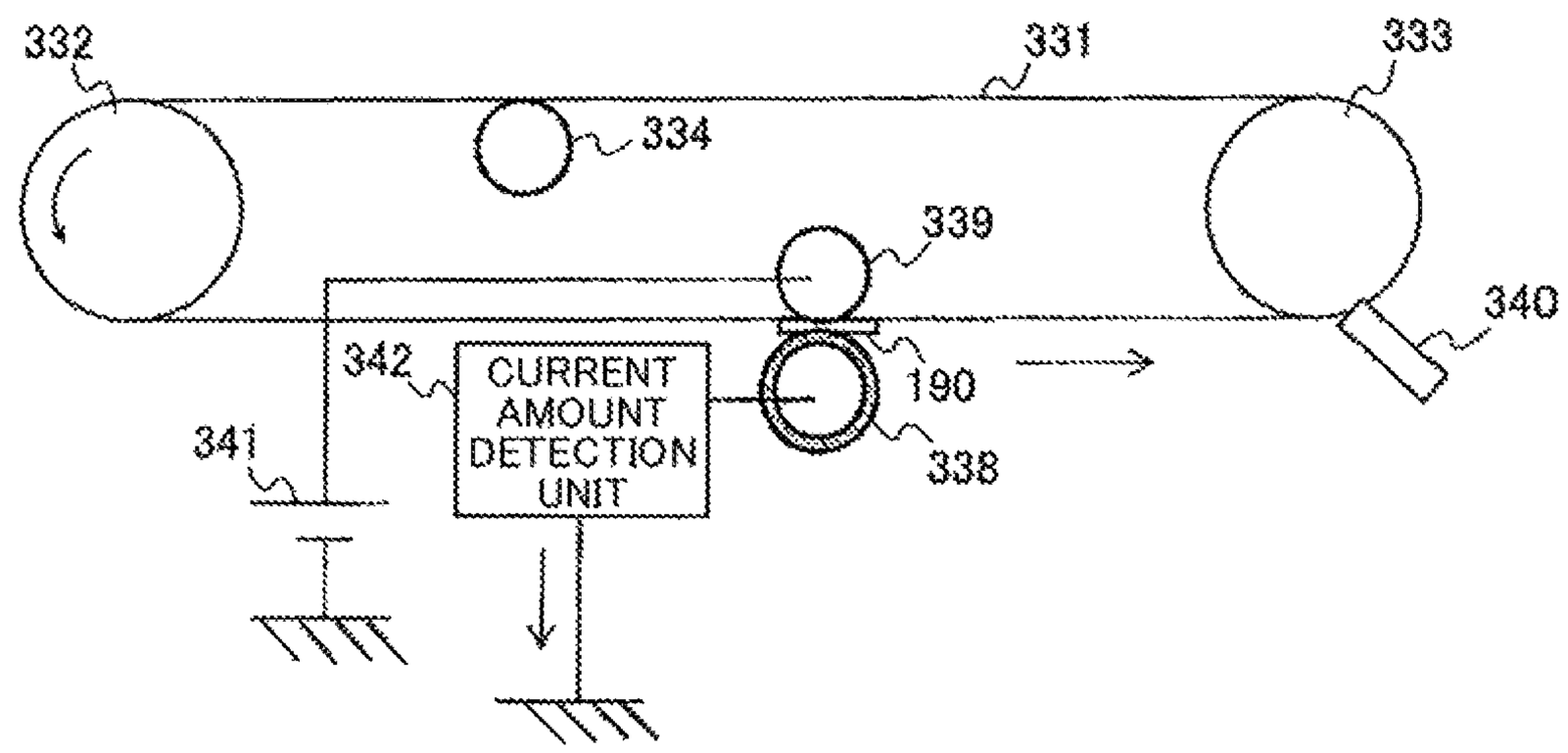

Fig.12B

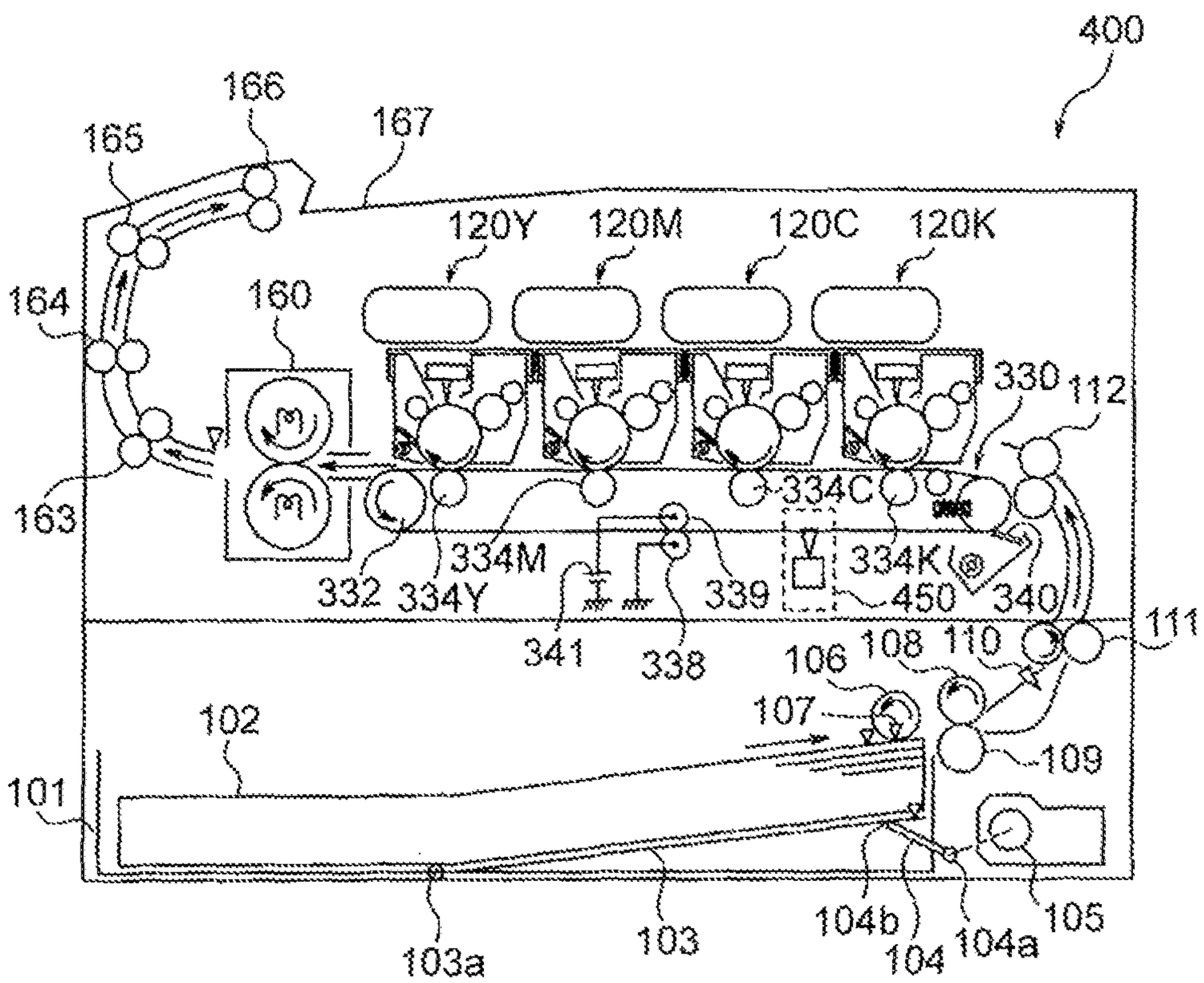
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Fig.13

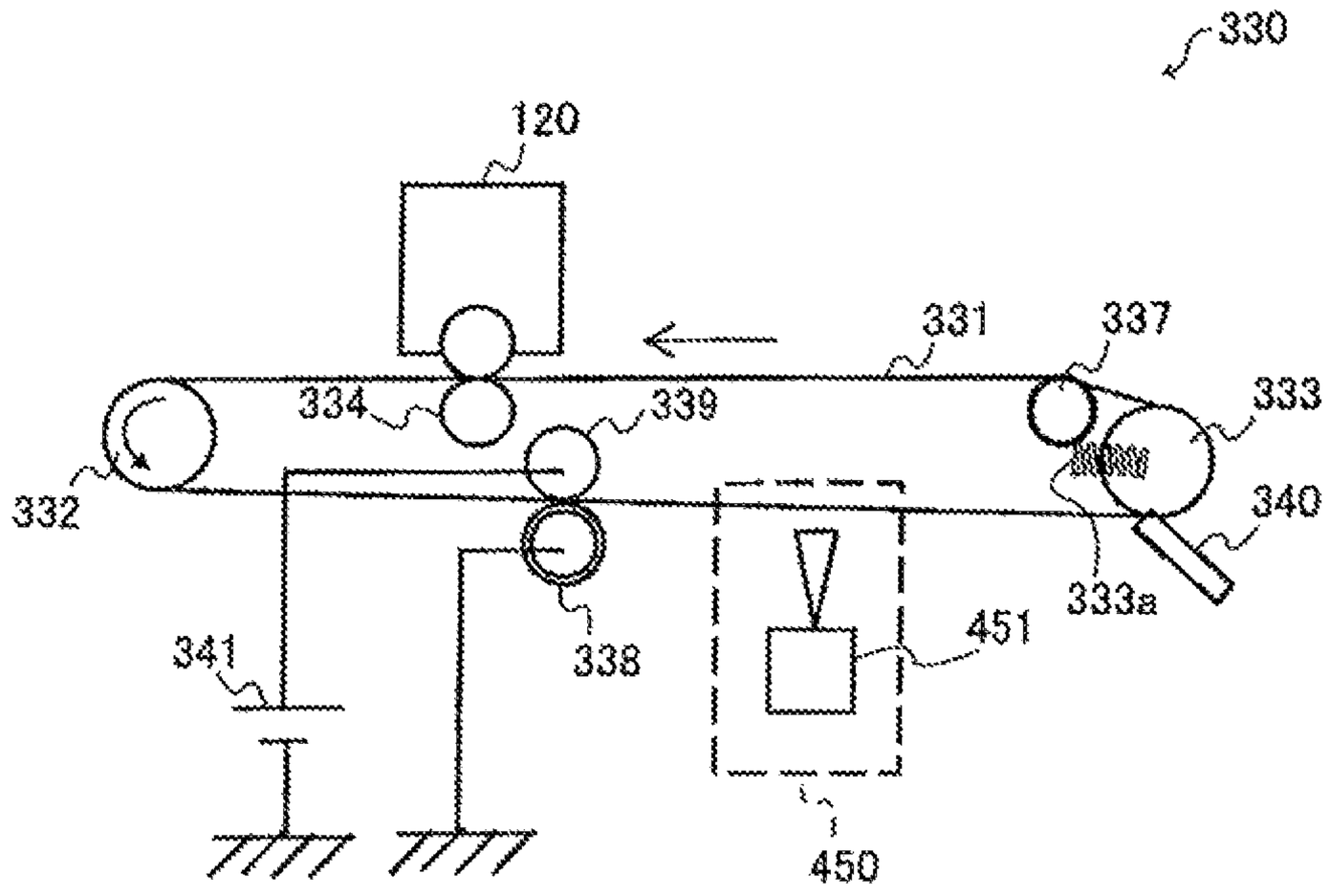


Fig.14

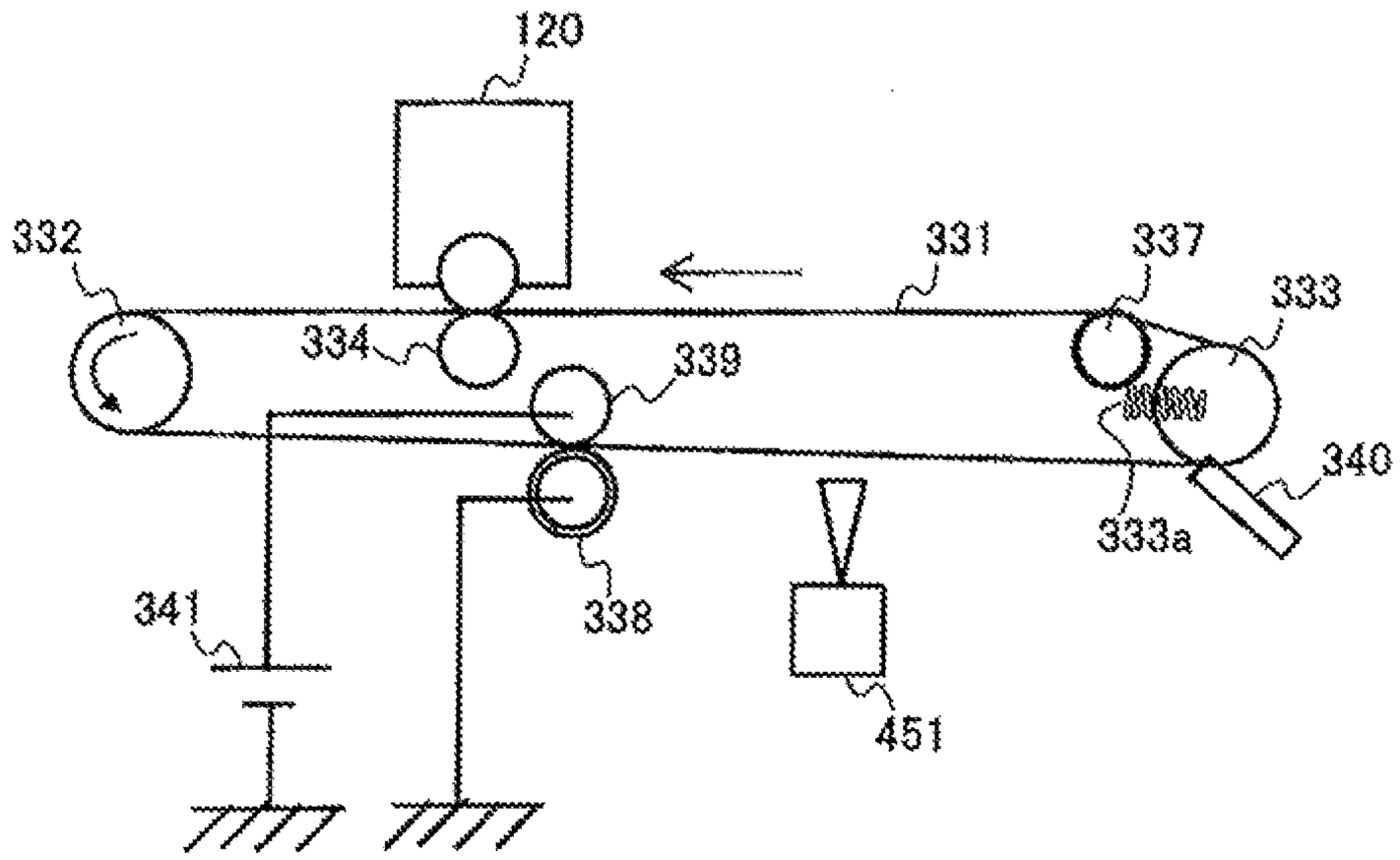


Fig.15A

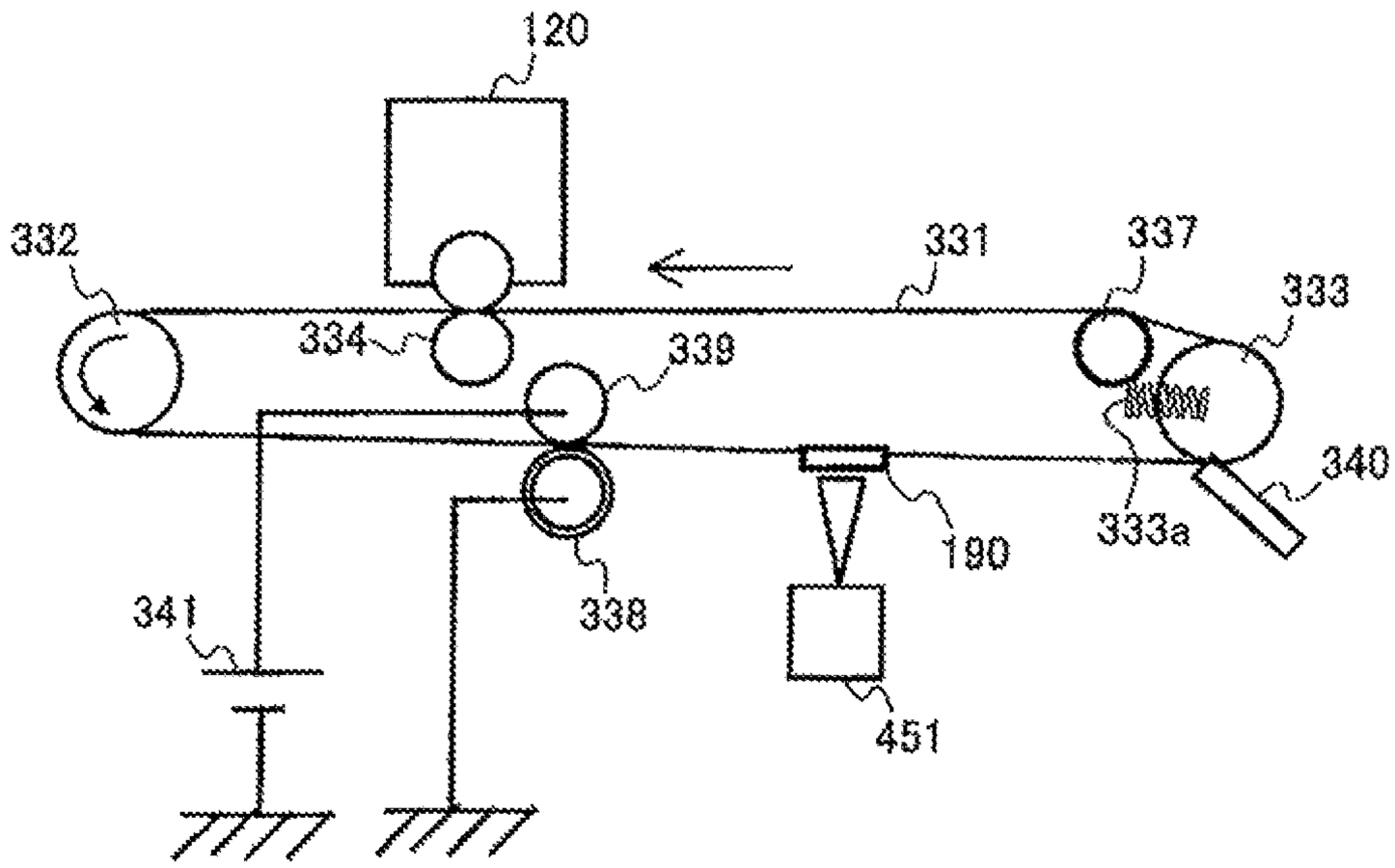
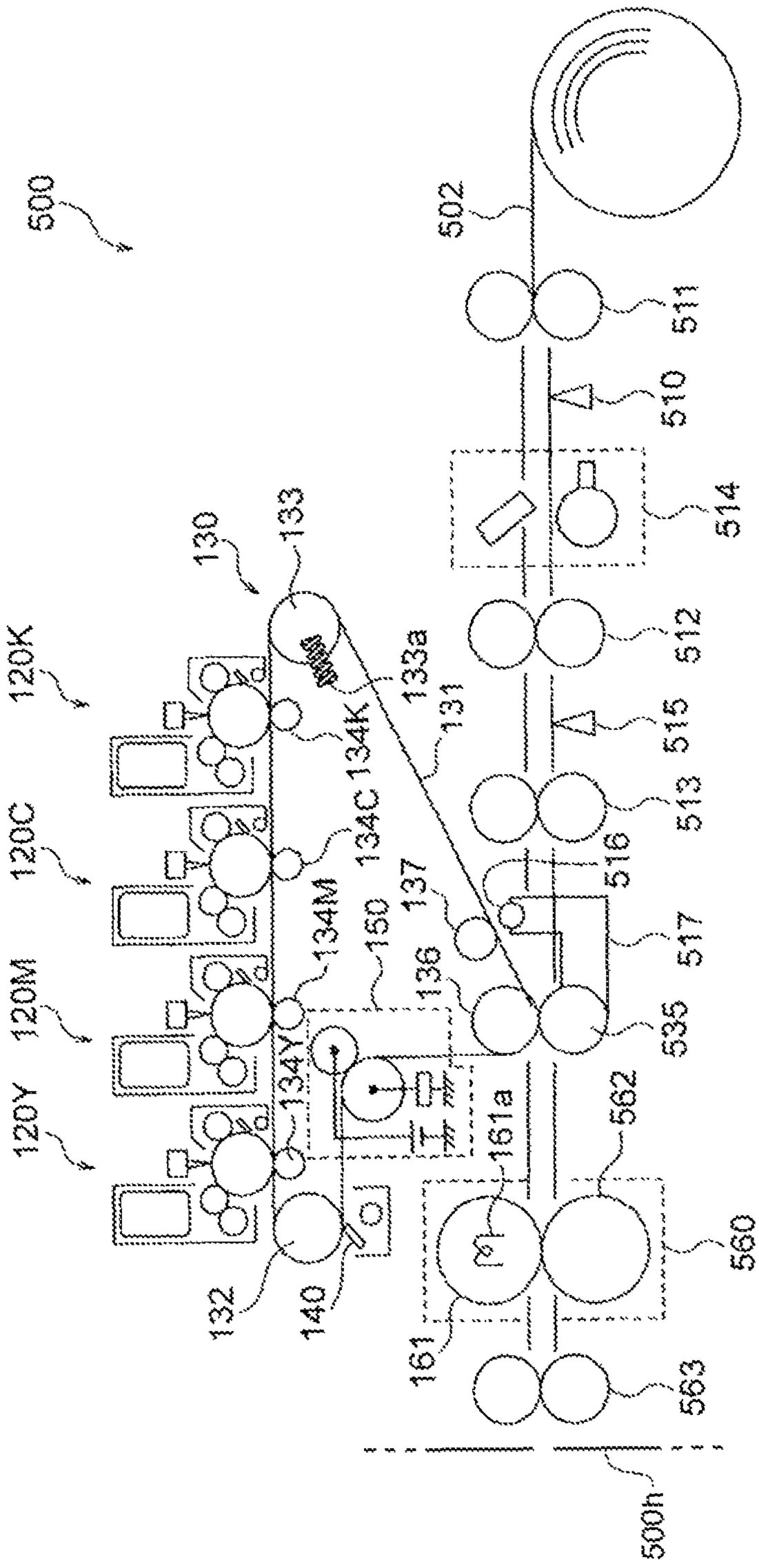


Fig.15B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132
140

FIG.16

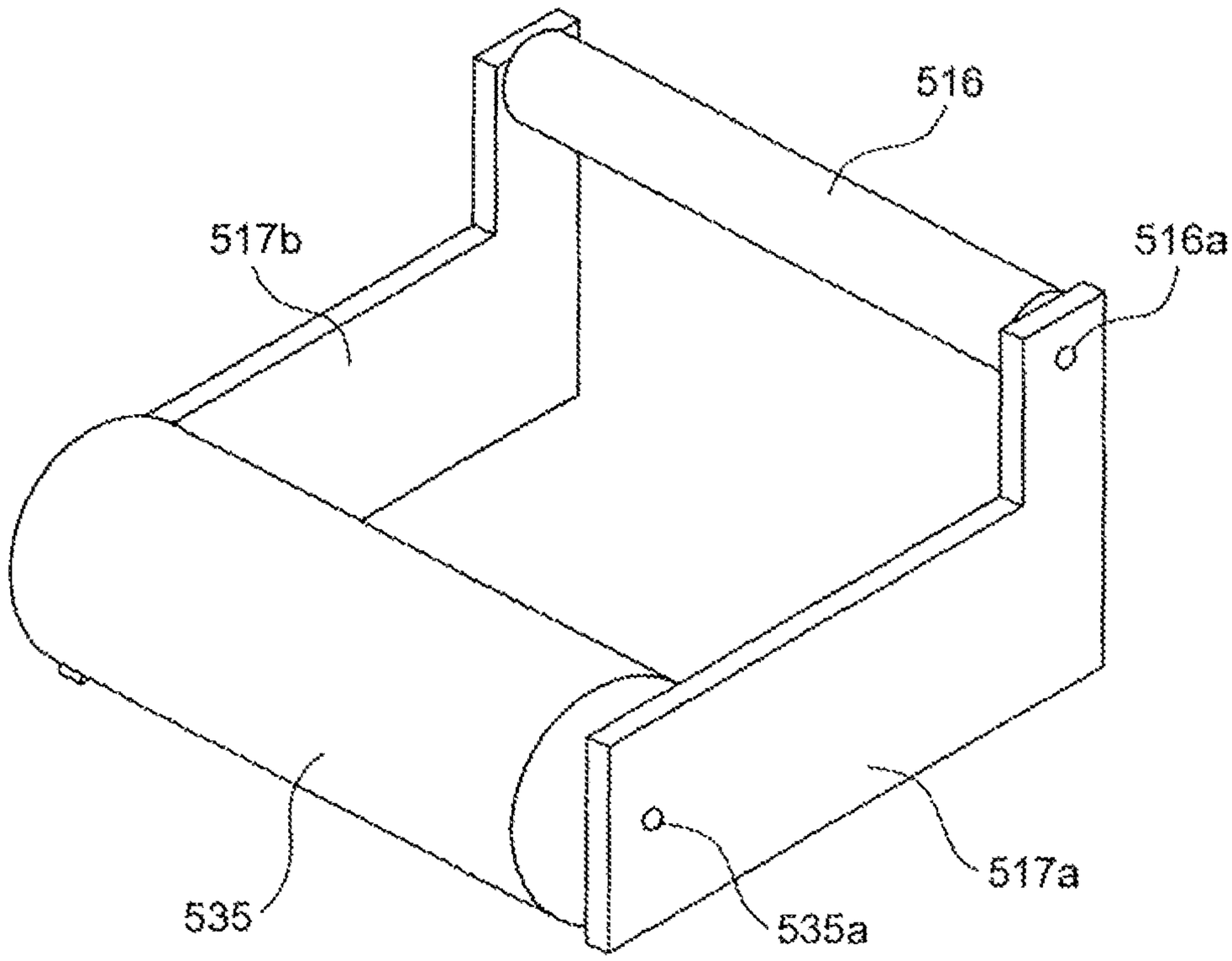


Fig.17

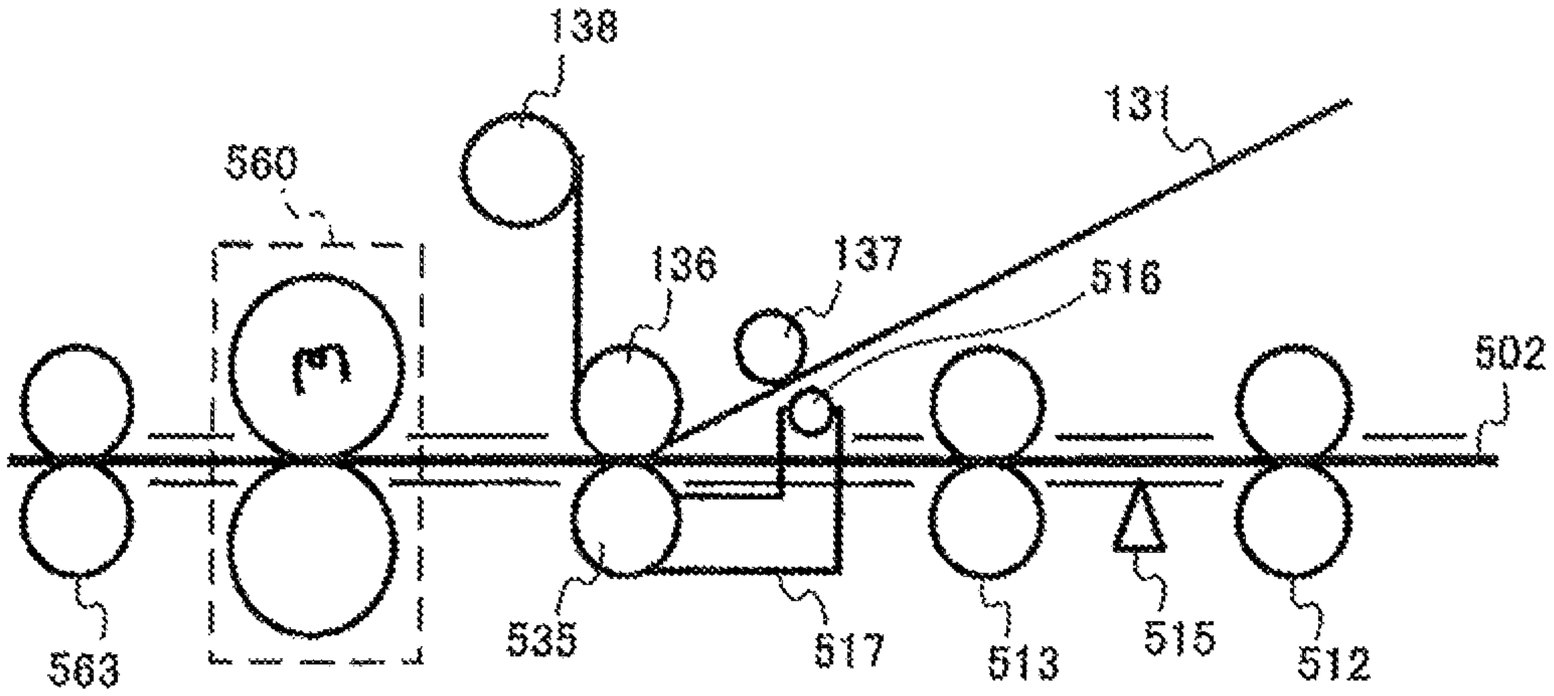


Fig.18A

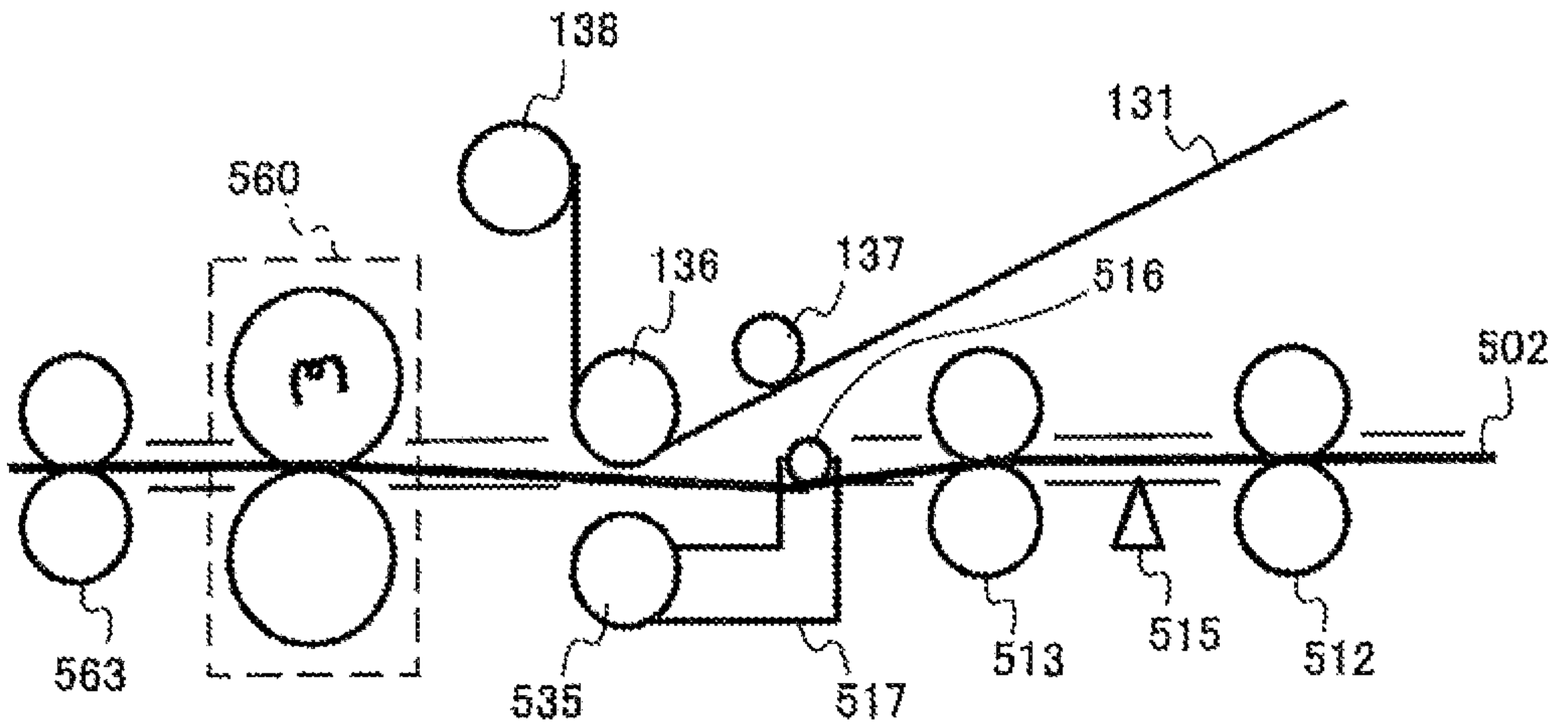
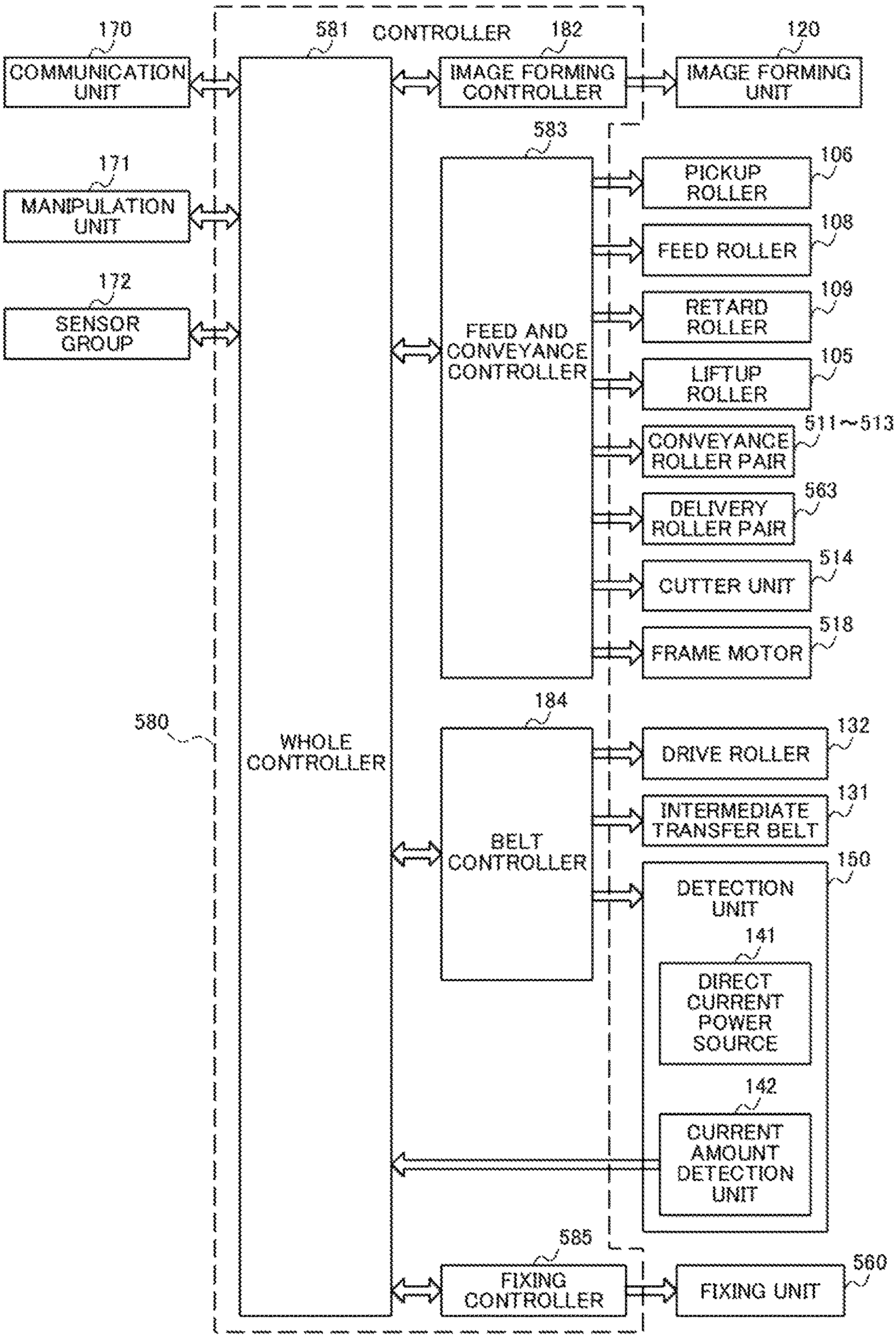


Fig.18B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FEED ROLLER
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RETARD ROLLER
105
LIFTUP ROLLER
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CONVEYANCE ROLLER PAIR
563
DELIVERY ROLLER PAIR
514
CUTTER UNIT
518
FRAME MOTOR
FEED AND CONVEYANCE CONTROLLER
580
WHOLE CONTROLLER
184
132
DRIVE ROLLER
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INTERMEDIATE TRANSFER BELT
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DETECTION UNIT
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DIRECT CURRENT POWER SOURCE
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CURRENT AMOUNT DETECTION UNIT
BELT CONTROLLER
585
FIXING CONTROLLER
560
FIXING UNIT

Fig.19

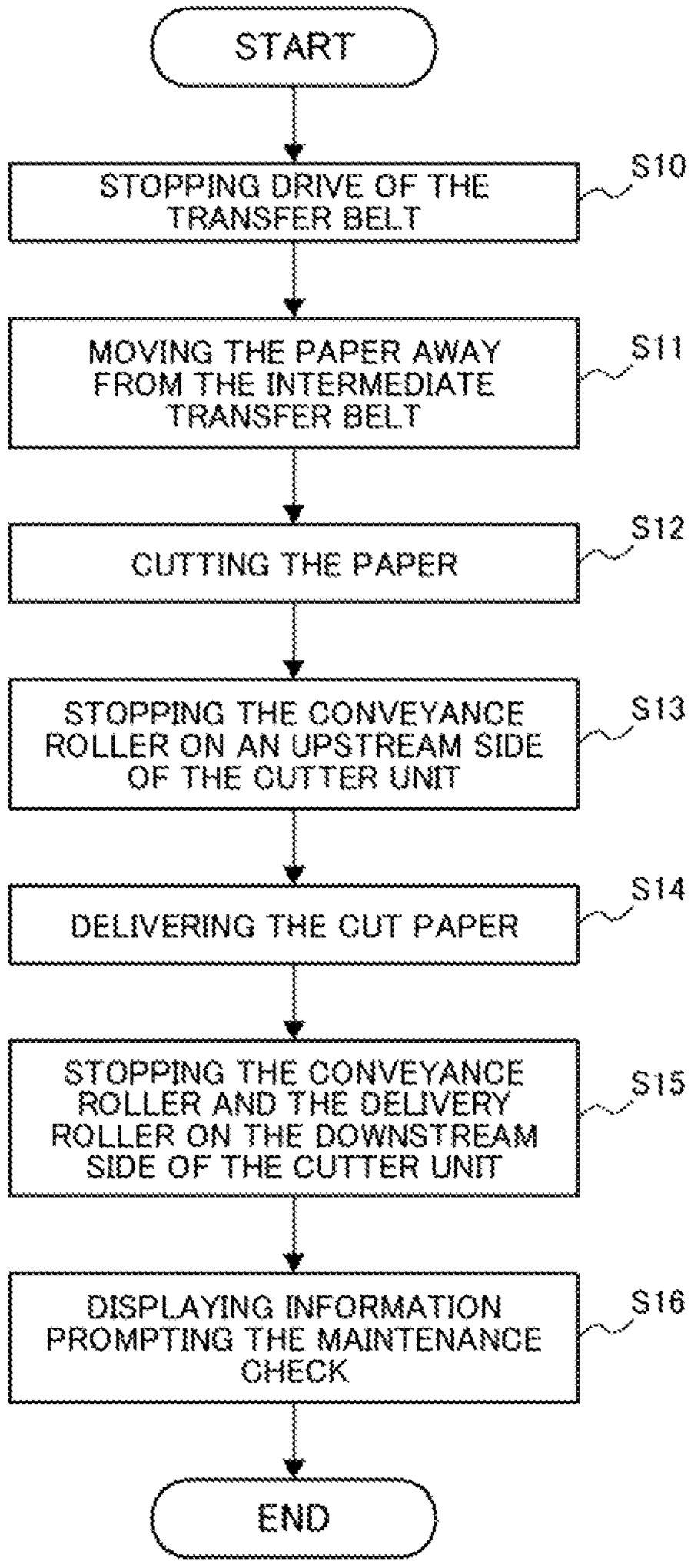
START
STOPPING DRIVE OF THE TRANSFER BELT
S10
MOVING THE PAPER AWAY FROM THE INTERMEDIATE TRANSFER BELT
S11
CUTTING THE PAPER
S12
STOPPING THE CONVEYANCE ROLLER ON AN UPSTREAM SIDE OF THE CUTTER UNIT
S13
DELIVERING THE CUT PAPER
S14
STOPPING THE CONVEYANCE ROLLER AND THE DELIVERY ROLLER ON THE DOWNSTREAM SIDE OF THE CUTTER UNIT
S15
DISPLAYING INFORMATION PROMPTING THE MAINTENANCE CHECK
S16
END

Fig.20

IMAGE FORMING APPARATUS USING DETECTION FEEDBACK TO CONTROL BELT MOVEMENT

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority benefits under 35 USC, section 119 on the basis of Japanese Patent Application No. 2016-035318, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an image forming apparatus and a method for controlling the image forming apparatus and, more particularly, to an image forming apparatus and a method for controlling the image forming apparatus detecting a foreign object attaching to a belt.

2. Description of Related Art

Image forming apparatuses have been known forming images on a label sheet using an intermediate transfer belt. A conventional image forming apparatus transfers toner images in respective colors transferred to a photosensitive drum sequentially to an intermediate transfer belt in an overlapping manner, thereby forming multicolor toner images overlapping the toner images in respective colors on the intermediate transfer belt. The multicolor toner images transferred to the intermediate transfer belt are further transferred onto a label seal by a transfer roller, as disclosed in, e.g., Japanese Patent Application Publication (A1), No. 2015-168216.

Such a prior art image forming apparatus may be suffered from attachment of foreign object such as, e.g., labels to the intermediate transfer belt. Under such a situation, if the foreign object attached to the intermediate transfer belt reaches a cleaning unit or an image forming unit, the cleaning unit or the image forming unit may be damaged or suffered from getting dirty, thereby lowering quality of the images to be formed. Where the quality of the images is graded down, it is required to replace the belt portion including the intermediate transfer belt, or the image forming unit with new one, so that there arises problems such as, e.g., increased inactive times, increased costs, and shortened life time of the parts.

It is therefore an object of the invention to provide an image forming apparatus and a method for controlling the image forming apparatus in which the belt can be stopped before any foreign object on the belt reaches a cleaning unit or an image forming unit.

SUMMARY OF THE INVENTION

According to an aspect of the invention, an image forming apparatus includes: a movable endless belt; an image forming unit forming a developer image; a transfer unit transferring the developer image to a medium on a downstream side of the image forming unit in a moving direction of the belt; a belt cleaning unit cleaning the belt on a downstream side of the transfer unit in the moving direction of the belt; a detection unit detecting a surface state of the belt on a downstream side of the transfer unit in the moving direction of the belt and on an upstream side of the belt cleaning unit in the moving direction of the belt; and a control unit stopping move of the belt based on a result detected at the detection unit.

In another aspect of the invention, a method for controlling an image forming apparatus having: a movable endless belt; an image forming unit forming a developer image; a transfer unit transferring the developer image to a medium on a downstream side of the image forming unit in a moving direction of the belt; and a belt cleaning unit cleaning the belt on a downstream side of the transfer unit in the moving direction of the belt, the method comprising the steps of: detecting a surface state of the belt at a position on a downstream side of the transfer unit in the moving direction of the belt and on an upstream side of the belt cleaning unit in the moving direction of the belt; and stopping move of the belt based on the detected result of the surface state of the belt.

These and other objects, features, aspects and advantages of the disclosed image forming apparatus and its controlling method will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the attached drawings which form a part of this original disclosure:

FIG. **1** is a schematic view showing a structure of an image forming apparatus according to a first embodiment of the invention;

FIG. **2** is a perspective view showing an intermediate transfer belt according to the first embodiment;

FIG. **3** is an illustration showing a structure of a belt unit and a detection unit according to the first embodiment;

FIG. **4** is a block diagram showing an essential structure of a control system and a drive system of the image forming apparatus according to the first embodiment;

FIGS. **5**A, **5**B are schematic diagrams illustrating operation of the image forming apparatus according to the first embodiment;

FIG. **6** is a schematic view showing a structure of an image forming apparatus according to a second embodiment of the invention:

FIG. **7** is a schematic diagram showing a structure of a belt unit and a detection unit according to the second embodiment;

FIG. **8** is a block diagram showing an essential structure of a control system and a drive system of the image forming apparatus according to the second embodiment;

FIGS. **9**A, **9**B are schematic diagrams illustrating operation of the image forming apparatus according to the first embodiment;

FIG. **10** is a schematic view showing a structure of an image forming apparatus according to a third embodiment of the invention;

FIG. **11** is a schematic diagram showing a structure of a belt unit and a detection unit according to the third embodiment;

FIGS. **12**A, **12**B are schematic diagrams illustrating operation of the image forming apparatus according to the third embodiment;

FIG. **13** is a schematic view showing a structure of an image forming apparatus according to a fourth embodiment of the invention;

FIG. **14** is a schematic diagram showing a structure of a belt unit and a detection unit according to the fourth embodiment;

FIGS. **15**A, **15**B are schematic diagrams illustrating operation of the image forming apparatus according to the fourth embodiment;

FIG. **16** is a schematic view showing an essential structure of an image forming apparatus according to a fifth embodiment of the invention;

FIG. **17** is a perspective view showing a secondary roller, a support bar, and a support frame according to the fifth embodiment of the invention;

FIGS. **18**A, **18**B are schematic diagrams illustrating states of the support frame in an up and down motion operation according to the fifth embodiment;

FIG. **19** is a block diagram showing an essential structure of a control system and a drive system of the image forming apparatus according to the fifth embodiment; and

FIG. **20** is a flowchart showing a processing when a whole controller detects a foreign object according to the fifth embodiment

DETAILED DESCRIPTION OF EMBODIMENTS

Hereinafter, embodiments according to the invention are described in detail with reference to the drawings.

First Embodiment

FIG. **1** shows a schematic diagram showing a structure of an image forming apparatus **100** according to the first embodiment. A paper tray **101** has an interior accumulating paper **102** as media and is detachably attached to the image forming apparatus **100**. A paper mounting plate **103** pivotally supported at a support shaft **103***a* is arranged inside the paper tray **101** to load the paper **102** on the paper mounting plate **103**.

A lift-up lever **104** is provided pivotally around a support shaft **104***a* on a side loading the paper **102** of the paper tray **101**. The support shaft **104***a* engages a lift-up motor **105** in a separable way. Where the paper tray **101** is attached to the image forming apparatus **100**, the lift-up lever **104** engages the lift-up motor **105** to control drive of the lift-up motor **105** by a feed and conveyance controller **183** as described below (see, FIG. **4**).

When the lift-up lever **104** rotates, a tip **104***b* of the lift-up lever **104***b* lifts up the paper mounting plate **103**, thereby lifting up the paper **102** stacked on the paper mounting plate **103**. The paper **102** comes in contact with a pickup roller **106** where lifted up to a certain level, and a moving-up detection unit **107** detects the contact. The feed and conveyance controller **183** stops the lift-up motor **105** based on detected results of the moving-up detection unit **107**.

The pickup roller **106** feeds out the paper **102** on the paper tray **101** together with a feed roller **108** and a retard roller **109** disposed as a pair in contact to each other. The pickup roller **106** and the feed roller **108** are driven to rotate in an arrow direction by a feed motor, not shown. The pickup roller **106** and the feed roller **108** incorporate inside an one-way clutch, respectively, so that the rollers can idle in the arrow direction even where the rotational drive is stopped. The pickup roller **106** takes out the paper **102** from the paper tray **101**, and the feed roller **108** and the retard roller **109** feed out the paper **102** sheet by sheet sequentially to a conveyance route even where plural sheets of the paper **102** are fed at the same time. Operation of the pickup roller **106**, the feed roller **108**, and the retard roller **109** is controlled by the feed and conveyance controller **183** described below.

A paper sensor **110**, a conveyance roller pair **111** restricting obliquely feeding of the paper **102**, a conveyance roller pair **112** feeding the paper **102** to a portion at which the toner images are transferred to the paper **103**, are disposed on a downstream side of the feed roller **108** and the retard roller **109** in the conveyance direction of the paper **102**. Those conveyance roller pairs **111**, **112** receive force via a drive transmission means, not shown, from a conveyance drive motor, not shown, and operation of the pairs is controlled by the feed conveyance controller **183** as described below.

The image forming apparatus **100** has four image forming units **120**K, **120**Y, **120**M, **120**C forming toner images in respective colors of black, yellow, magenta, and cyan. In this specification, those image forming units are collectively referred to as image forming units **120** where distinction among the colors is not required. The image forming units **120** are disposed above the belt unit **130**. Because the interior structures of the image forming units **120** are in common, the image forming unit **120**K for black color is exemplified to explain the interior structure.

The image forming unit **120**K is formed with a photosensitive drum **121** serving as an image carrier to form toner images as developer images. The photosensitive drum **121** is rotatable in an arrow direction. The image forming unit **120**K includes a charge roller **122**, an exposure apparatus **123**, a toner container **124**, a supply roller **125**, a developing roller **126**, and a drum cleaning unit **127**.

The charge roller **122** supplies electric charges to the surface of the photosensitive drum **121** to charge the surface. The exposure apparatus **123** selectively radiates light the surface of the charged photosensitive drum **121** to form electrostatic latent images. The toner container **124** contains toner as a developer. The supply roller **125** supplies to the developing roller **126** the toner contained in the toner container **124**. The developing roller **126** attaches the toner to the surface of the photosensitive drum **121** formed with the electrostatic latent images to form the toner images as the developer images. The drum cleaning unit **127** removes remaining toner after the toner images on the photosensitive drum **121** are transferred. It is to be noted that drums and rollers provided in the image forming unit **120** receive force from a drive source or sources, not shown, via such as gears and rotate. An image forming controller **182** as described below shown in FIG. **4** controls operation of the image forming unit **120**.

The belt unit **130** transfers the toner images formed by the image forming unit **120** to an intermediate transfer belt **131**, and transfers the toner images to the paper **102** supplied from the paper tray **101**. The belt unit **130** includes the intermediate transfer belt **131**, a drive roller **132**, a tension roller **133**, primary transfer rollers **134**K, **134**C, **134**M, **134**Y (hereinafter, collectively referred to as primary transfer roller **134** if distinction of colors are not required), a secondary transfer roller **135**, a secondary transfer backup roller **136**, a guide roller **137**, a belt outside roller **138**, and a bias roller **139**.

The intermediate transfer belt **131** is tensioned by the drive roller **132**, the tension roller **131**, the primary transfer roller **134**, the secondary transfer backup roller **136**, the guide roller **137**, and the belt outside roller **138**, and is a movable belt. The intermediate transfer belt **131** is the endless belt as shown in FIG. **2** and has a conductivity. The outer surface of the intermediate transfer belt **131** is a surface to which the toner images are transferred.

The drive roller **132** is driven by a drive unit not shown. The tension roller **133** applies tension to the intermediate transfer belt **131** by an urging means such as a coil spring

133*a*. The primary transfer roller **134** is arranged as opposing to the photosensitive drum **121**, and a prescribed voltage applies to the primary transfer roller **134** to transfer to the intermediate transfer belt **131** the toner images formed on the photosensitive drum **121**. A prescribed voltage applies to the secondary transfer roller **135** to transfer the toner images transferred to the intermediate transfer belt **131** further to the paper **102**. In other words, the secondary transfer roller **135** functions as a transfer unit for transferring the toner images to the paper **102**. The secondary transfer backup roller **136** opposes to the secondary transfer roller **135** and assists the roller when the toner images are transferred to the paper **102**.

The guide roller **137** guides a moving direction of the intermediate transfer belt **131**. The belt outside roller **138** tensions the intermediate transfer belt **131** from a side of the outer surface of the intermediate transfer belt **131**. The bias roller **139** is disposed at a portion opposing the belt outside roller **138** astride the intermediate transfer belt **131**. The belt outside roller **138** and the bias roller **139** are closely contacting the intermediate transfer belt **131**.

The belt cleaning unit **140** removing remaining toner on the intermediate transfer belt **131** is disposed on a downstream side of the secondary transfer roller **135** in the moving direction of the intermediate transfer belt **131**. The belt unit **130** is formed with a direct current power source **141** for applying a prescribed voltage between the bias roller **139** and the belt outside roller **138** to render toner in an excessive amount not remain on the intermediate transfer belt **131**. A current amount detection unit **142** is provided to the belt unit **130** for detecting an amount of current flowing between the bias roller **139** and the belt outside roller **138**. The bias roller **139** and the belt outside roller **138**, the direct current power source **141**, and the current amount detection unit **142** function as a detection unit **150** detecting a value for detecting as to whether any foreign object is attached to the intermediate transfer belt **131**. It is to be noted that the foreign object is an object not deemed as a target to be cleaned. The foreign object is a thing other than the toner, and for example, may be the paper **102** or a part of the paper **102**. The detection unit **150** is disposed on an upstream side of the secondary transfer roller **135** in the moving direction of the intermediate transfer belt **131** and on an upstream side of the belt cleaning unit **140** in in the moving direction of the intermediate transfer belt **131**. The detection unit **150** detects the surface state of the intermediate transfer belt **131**. Details of the detection unit **151** are described below. It is to be noted that a belt controller **184** (see FIG. **4**) controls the operation of the belt unit **130**.

A fixing unit **160** is constituted of a roller pair, or namely an upper roller **161** and a lower roller **162**, and fixes the toner images to the paper **102** in application of beat and pressure to the toner images transferred to the paper **102**. The upper roller **161** includes a halogen lamp **161***a* provided inside serving as a heat source, and the surface of the upper roller **161** is formed of an elastic body. The lower roller **162** includes a halogen lamp **162***a* provided inside serving as a heat source, and the surface of the lower roller **162** is also formed of an elastic body. A fixing controller **185** (see FIG. **5**) controls operation of respective portions of the fixing unit **160**.

After fixing the toner images, the paper **102** is conveyed with delivery roller pairs **163**, **164**, **165**, **166** and delivered to a stacker unit **167**. Drive force is transmitted to the delivery roller pairs **163**, **164**, **165**, **166** form a drive power source, not shown, via a drive transmission means, not shown, and a feed and conveyance controller **184** (see, FIG. **4**) described below controls operation of the delivery roller pairs **163**, **164**, **165**, **166**. A paper sensor **168** disposed on an output side of the fixing unit **160** detects drive timings of the delivery roller pairs **163**, **164**, **165**, **166**.

FIG. **3** is a schematic diagram showing a structure of the belt unit **130** and the detection unit **150**. The drive roller **132**, the tension roller **133**, the primary transfer roller **134**, the secondary transfer backup roller **136**, the guide roller **137**, and the bias roller **139** are arranged inside the intermediate transfer belt **131** in the belt unit **130**. The belt outside roller **138** is disposed outside the intermediate transfer belt **131** at the belt unit **130**.

The detection unit **150** includes the direct current power source **141**, the belt outside roller **138**, the bias roller **139**, and the current amount detection unit **142**. The direct current power source **141** is a power source applying a prescribed direct current voltage to the bias roller **139** and the current amount detection unit **142**. The bias roller **139** serves as a first terminal flowing a current to the intermediate transfer belt **131** whereas the belt outside roller **138** serves as a second terminal flowing a current to the intermediate transfer belt **131**. In FIG. **3**, the direct current power source **141** is provided on a side of the bias roller **139** but can be provided on a side of the belt outside roller **138**.

The bias roller **139** and the belt outside roller **138** are disposed on the in the moving route of the intermediate transfer belt **131** between the belt cleaning unit **140** and the secondary transfer roller **135**. More specifically, the bias roller **139** and the belt outside roller **138** are disposed on a downstream side of the secondary transfer roller **135** in the moving direction of the intermediate transfer belt **131** and on an upstream side of the belt cleaning unit **140** in the moving direction of the intermediate transfer belt **131**.

The bias roller **139** and the belt outside roller **138** sandwich the intermediate transfer belt **131**, and any one of rollers contacts an outer surface from which any foreign object on the intermediate transfer belt **131** is detected. The surface detecting the foreign object on the intermediate transfer belt **131** is an outer surface of the intermediate transfer belt **131**. The bias roller **139** and the belt outside roller **138** are disposed at portions at which the detected foreign object does not reach the belt cleaning unit **140** by stopping the move of the intermediate transfer belt **131**, where it is judged or detected as the foreign object is attached to the intermediate transfer belt **131** based on the current value detected at the current amount detection unit **142**.

The current amount detection unit **142** detects the current value of the current flowing between the bias roller **139** and the belt outside roller **138**. It is to be noted that the current amount detection unit **142** can be positioned at any location as far as the unit can detect the current amount between the bias roller **139** and the belt outside roller **138**, and can be placed between the direct current power source **141** and the bias roller **139**. The bias roller **139** and the belt outside roller **138** are not limited to a roller mechanism and may be formed of a sliding mechanism using a rigid body.

FIG. **4** is a block diagram showing an essential structure of a control system and a drive system of the image forming apparatus **100**. A communication unit **170** communicates a host apparatus, not shown. For example, the communication unit **170** receives printing data and control commands from the host apparatus, not shown. A manipulation unit **171** includes, e.g., a display panel as a display unit for displaying states of the image forming apparatus **100**, and entry keys as an input unit for entering instructions given from a user to the image forming apparatus **100**. A sensor group **172** is made of various sensors monitoring operation state of the

image forming apparatus **100**, such as, e.g., a paper sensors **110**, **168** for detecting the paper position, a write sensor, a temperature and humidity sensor, and a density sensor.

A controller **180** controls processing in the image forming apparatus **100**. The controller **180** includes a whole controller **181**, the image forming controller **182**, the feed and conveyance controller **183**, the belt controller **184**, and the fixing controller **185**. The controller **180** is constituted of one or more processing circuits having such as, e.g., a microprocessor, ROMs, RAMs, input output ports, and a timer.

The whole controller **181** controls processing of the entire image forming apparatus **100**. For example, the whole controller **181** receives the printing data and the controller commands from the host apparatus, not shown, via the communication unit **170**, and controls sequences of the entire image forming apparatus **100** to perform the printing operation.

The image forming controller **182** controls operations of the image forming unit **120** forming toner images according to the instructions of the whole controller **181**, e.g., rotation operation of the photosensitive drum **121**, and exposure operation of the exposure apparatus **123**.

The feed and conveyance controller **183** controls operation of the various type rollers and the lift-up motor **105** according to the instructions from the whole controller **181**. For example, the feed and conveyance controller **183** executes rotation operation of the pickup roller **106** and the feed roller **108**, and torque generation operation of the retard roller **109**, and picks up the paper **102** sheet by sheet. The feed and conveyance controller **183** controls rotation operation of the conveyance roller pairs **111**, **112** and the delivery roller pairs **163** to **166** according to the instructions of the whole controller **181**.

The belt controller **184** controls operation of the belt unit **130** and the detection unit **150** according to the instructions of the whole controller **181**. For example, the belt controller **184** controls rotation operation of the drive roller **132** driving the intermediate transfer belt **131** and controls transfer voltage bias to the intermediate transfer belt **131** and direct current voltage bias to the detection unit **150**. The whole controller **181** gives to the belt controller **184** the instruction for stopping the rotation operation of the drive roller **132** of the intermediate transfer belt **131** based on the detected result of the detection unit **150**, or namely based on the current value detected by the current amount detection unit **142** of the detection unit **150**. The belt controller **184** stops rotation drive of the drive roller **132** according to the instruction of the whole controller **181**. With this operation, the intermediate transfer belt **131** stops running.

The fixing controller **185** controls the fixing unit **160** according to the instruction of the whole controller **181**. For example, the fixing controller **185** controls the upper roller **161**, the lower roller **162**, and rotation drive sources of the upper roller **161** and the lower roller **162**, as well as the power sources of the halogen lamps **161***a*, **162***a*.

FIGS. **5**A, **5**B are schematic diagrams describing the operation of the image forming apparatus **100**. FIG. **5**A is a schematic diagram showing operation when no foreign object exists. Where no foreign object exists between the belt outside roller **138** and the intermediate transfer belt **131**, close contact property is maintained between the intermediate transfer belt **131** and the belt outside roller **138**. Accordingly, the current value i of the current flowing between the belt outside roller **138** and the bias roller **139** takes a value within a prescribed range as shown with following Formula (1).

$$I\min \leq i \leq I\max \qquad \text{Formula(1)}$$

In this situation, the whole controller **181** judges the current value i detected by the current amount detection unit **142** as the normal value, and judges or detects that no foreign object is attached to the intermediate transfer belt **131**. The whole controller **181** provides the instruction executing the rotation operation of the drive roller **132** without providing any instruction stopping the printing operation to the belt controller **184**. The belt controller **184** receiving such an instruction executes the rotation drive instruction of the drive roller **132** to rotationally drive the drive roller **132**.

FIG. **5**B is a schematic diagram showing operation when some foreign object exists. Where some foreign object **190** exists between the belt outside roller **138** and the intermediate transfer belt **131**, a portion at which the close contact property between the intermediate transfer belt **131** and the belt outside roller **138** is partly not maintained can be generated. Accordingly, the current value i of the current flowing between the belt outside roller **138** and the bias roller **139** takes a value out of a prescribed range as shown with following Formula (2).

$$i < I\min \text{ or } I\max < i \qquad \text{Formula(2)}$$

In this situation, the whole controller **181** judges the current value i detected by the current amount detection unit **142** as the abnormal value, and judges or detects that some foreign object is attached to the intermediate transfer belt **131**. The whole controller **181** therefore provides an instruction stopping the rotation operation of the drive roller **132** to the belt controller **184**. The belt controller **184**, upon reception of such an instruction, executes the rotation stop instruction of the drive roller **132**, and the drive roller **132** stops rotation drive before the foreign object **190** reaches the belt cleaning unit **140**.

As described above, according to the first embodiment, where the value detected at the detection unit **150** indicates that the foreign object **190** attaches to the intermediate transfer belt **131**, the foreign object **190** cannot reach the belt cleaning unit **140** and the image forming unit **120** by stopping the rotation drive of the drive roller **132** driving the intermediate transfer belt **131**, thereby preventing those units from getting dirty or receiving damages.

Second Embodiment

The second embodiment is described next. It is to be noted that structures which is the same as those in the first embodiment are assigned with the same reference numbers, and the explanation thereof is omitted for the sake of brevity. For the operations and advantages the same as those in the first embodiment, the explanation is omitted for the sake of brevity.

FIG. **6** is a structural diagram showing structure of an image forming apparatus **200** according to the second embodiment. The image forming apparatus **200** according to the second embodiment has substantially the same structure as the image forming apparatus **100** according to the first embodiment except a detection unit **250**.

FIG. **7** is a schematic diagram showing the structure of the belt unit **130** and the detection unit **250**. At the belt unit **130**, disposed inside the intermediate transfer belt **131** are the drive roller **132**, the tension roller **133**, the primary transfer rollers **134**, the secondary transfer backup roller **136**, the guide roller **137**, and the bias roller **139**. The belt outside roller **138** is disposed outside the intermediate transfer belt **131** at the belt unit **130**. With the belt unit **130**, the direct current power source **141** is formed to apply a prescribed

voltage between the bias roller **139** and the belt outside roller **138** to render the toner in an excessive amount not remain on the intermediate transfer belt **131**.

The detection unit **250** according to the second embodiment detects, with photo sensors **251** serving as a light amount detection unit, a detection value for judging as to whether any foreign object is attached to the intermediate transfer belt **131** at a position on a downstream side of the secondary transfer roller **135** in the moving direction of the intermediate transfer belt **131** and on an upstream side of the belt cleaning unit **140** in the moving direction of the intermediate transfer belt **131**. The plural photo sensors **251** face the outer surface as a surface on which some foreign object on the intermediate transfer belt **131** is to be detected, and are arranged in a line extending in a direction intersecting to the moving direction of the intermediate transfer belt **131**, or namely, e.g., a rearward direction in FIG. **7**. The photo sensors **251** herein are made of reflection type photo sensors, but can be made of transmission type photo sensors.

FIG. **8** is a block diagram showing an essential structure of the control system and the drive system of the image forming apparatus **200**. The control system and the drive system of the image forming apparatus **200** according to the second embodiment are substantially the same as the control system and the drive system of the image forming apparatus **100** according to the first embodiment except a controller **280** and a detection unit **250**. The controller **280** in the second embodiment has substantially the same structure as the controller **180** in the first embodiment except a whole controller **281** and a belt controller **284**.

The belt controller **284** controls the detection unit **250** to render the photo sensor **251** output the detection value. The whole controller **281** provides, to the belt controller **184**, the instruction stopping the rotation drive of the drive roller **132** of the intermediate transfer belt **131** based on the detection value of the photo sensor **251**. The belt controller **184** stops the rotation drive of the drive roller **132** according to the instruction of the whole controller **181**.

FIGS. **9**A, **9**B are schematic diagrams showing operation of the image forming apparatus **200**. FIG. **9**A is a schematic diagram showing operation when no foreign object exists. Where no foreign object exists between the belt outside roller **138** and the intermediate transfer belt **131**, reflection rate r detected at the photo sensor **251** is set to a value within a prescribed range as shown by following Formula (3).

$$Rmin \leq r \leq Rmax \qquad \text{Formula(3)}$$

In this situation, the whole controller **281** judges the reflection rate r detected with the photo sensor **251** as the normal value, and judges as no foreign object is attached to the intermediate transfer belt **131**. Therefore, the whole controller **281** provides an instruction executing the rotation drive of the drive roller **132** without providing any instruction stopping the rotation drive of the belt controller **284**. The belt controller **284**, upon receiving such an instruction, executes rotation drive instruction of the drive roller **132**, thereby rotationally driving the drive roller **132**.

FIG. **9**B is a schematic diagram showing operation when some foreign object **190** exists. Where some foreign object **190** exists between the belt outside roller **138** and the intermediate transfer belt **131**, the reflection rate r detected at the photo sensor **251** takes a value out of a prescribed range as shown with following Formula (4), according to the reflection light from the foreign object **190**.

$$r < Rmin \text{ or } Rmax < r \qquad \text{Formula(4)}$$

In this situation, the whole controller **281** judges the reflection rate r detected with the photo sensor **251** as the abnormal value, and judges as some foreign object is attached to the intermediate transfer belt **131**. Therefore, the whole controller **281** provides an instruction stopping the rotation drive of the drive roller **132** to the belt controller **284**. The belt controller **284**, upon receiving such an instruction, executes rotation stop instruction of the drive roller **132**, and the drive roller **132** stops the rotation drive before the foreign object **190** reaches the belt cleaning unit **140**.

The whole controller **281** may judge as some foreign object is attached if the abnormal value is detected at the photo sensors **251** in a prescribed number more than one among the photo sensors **251** arranged in the one line.

Although in the second embodiment the foreign object is detected by using the photo sensors **251**, the foreign object may be detected with, e.g., use of a line sensor and image processing. In such a modification, the whole controller **281** may detect the foreign object based on image data given from the line sensor. Although in the second embodiment the reflection type photo sensor is used as the photo sensor **251**, if a transmission type photo sensor is used as the photo sensor **251**, transmission rate r is used in lieu of the reflection rate r described above.

Third Embodiment

A third embodiment is described next. Any explanation of structures in the third embodiment substantially the same as those in the first or second embodiment is omitted by assigning the same reference numbers to those in the first or second embodiment. Any explanation of operations and advantages of the third embodiment substantially the same as those in the first or second embodiments is also omitted for the sake of brevity.

FIG. **10** is a structural diagram showing structure of an image forming apparatus **300** according to the third embodiment. The image forming apparatus **300** according to the third embodiment has substantially the same structure as the image forming apparatus **100** according to the first embodiment or the image forming apparatus **200** according to the second embodiment except a belt detection unit **330** and a detection unit **350**.

FIG. **11** is a schematic diagram showing the structures of the belt unit **330** and the detection unit **350** according to the third embodiment. The belt unit **330** includes a conveyance belt **331**, a drive roller **332**, a tension roller **333**, transfer rollers **334**, a guide roller **337**, a bias roller **339**, a belt outside roller **338**, and a belt cleaning unit **340**.

The conveyance belt **331** is tensioned by the drive roller **332**, the tension roller **333**, the transfer rollers **334**, the guide roller **337**, and the bias roller **339**, and is a movable belt. The conveyance belt **331** is an endless belt conveying the paper **102** supplied from the conveyance roller pair **112**. The conveyance belt **331** has a conductivity. In the third embodiment, the conveyance belt **331** is used in lieu of the intermediate transfer belt **131** in the first and second embodiments. The outer surface of the conveyance belt **331** is a surface conveying the paper **102**.

The drive roller **332** is driven by a drive unit, not shown. The tension roller **333** provides tension to the conveyance belt **331** by an urging means such as, e.g., a coil spring **333***a*. The transfer roller **334** is a transfer member facing the photosensitive drum **121** and being biased with a prescribed voltage to transfer the toner images formed on the photosensitive drum **121** to the paper **102** conveyed with the conveyance belt **331**.

The guide roller **337** guides the moving direction of the conveyance belt **331**. The belt outside roller **338** contacts the outer surface of the conveyance belt **331**. The bias roller **339** is disposed at a position opposing to the belt outside roller **338** astride the conveyance belt **331**. The belt outside roller **338** and the bias roller **339** closely contact the conveyance belt **331**.

The belt cleaning unit **340** removes toners attached to the conveyance belt **331**. A direct current power source **341** is provided for applying a prescribed voltage between the bias roller **339** and the belt outside roller **338** to render not remain on the conveyance belt **331** the toner in an excessive amount. A current amount detection unit **342** is provided at the belt unit **330** for detecting an amount of current flowing between the bias roller **339** and the belt outside roller **338**. The bias roller **339**, the belt outside roller **338**, the direct current power source **341**, and the current amount detection unit **342** function as the detection unit **350** detecting the value for detecting any foreign object attached to the conveyance belt **331**. The detection unit **350** is disposed on a downstream side of the transfer roller **334** in the moving direction of the conveyance belt **331** and on an upstream side of the belt cleaning unit **340** in the moving direction of the conveyance belt **331**.

It is to be noted that the control system and the drive system of the image forming apparatus **300** according to the third embodiment are substantially the same as those in the first embodiment. The belt controller **184** shown in FIG. **4**, however, controls operation of the conveyance belt **331** in lieu of the intermediate transfer belt **131**. The belt controller **184** controls the operation of the belt unit **330**.

FIGS. **12**A, **12**B are schematic diagrams describing operation of the image forming apparatus **300**. FIG. **12**A is a schematic diagram showing operation when no foreign object exists. Where no foreign object exists between the belt outside roller **338** and the conveyance belt **331**, close contact property is maintained between the conveyance belt **331** and the belt outside roller **338**. Accordingly, the current value i of the current flowing between the belt outside roller **338** and the bias roller **339** takes a value within a prescribed range likewise above Formula (1).

In this situation, the whole controller **181** judges the current value i detected by the current amount detection unit **342** as the normal value. The whole controller **181** provides the instruction executing the rotation operation of the drive roller **332** without providing any instruction stopping the printing operation to the belt controller **184**. The belt controller **184** upon receiving such an instruction executes the rotation drive instruction of the drive roller **332** to rotationally drive the drive roller **332**.

FIG. **12**B is a schematic diagram showing operation when some foreign object exists. Where some foreign object **190** exists between the belt outside roller **338** and the conveyance belt **331**, a portion at which the close contact property between the conveyance belt **331** and the belt outside roller **338** is partly not maintained can be generated. The current value i of the current flowing between the belt outside roller **338** and the bias roller **339** therefore takes a value out of a prescribed range likewise above Formula (2), in accordance with the conductivity of the foreign object.

In this situation, the whole controller **181** judges the current value i detected by the current amount detection unit **342** as the abnormal value. The whole controller **181** therefore provides an instruction stopping the rotation operation of the drive roller **332** to the belt controller **184**. The belt controller **184**, upon reception of such an instruction, executes the rotation stop instruction of the drive roller **332**, and the drive roller **332** stops rotation drive before the foreign object **190** reaches the belt cleaning unit **340**.

As described above, according to the third embodiment, where the value detected at the detection unit **350** indicates that the foreign object **190** attaches to the conveyance belt **331**, the foreign object **190** cannot reach the belt cleaning unit **340** and the image forming unit **120** by stopping the rotation drive of the drive roller **332** driving the conveyance belt **331**, thereby preventing those units from getting dirty or receiving damages.

Fourth Embodiment

A fourth embodiment is described next. Any explanation of structures in the fourth embodiment substantially the same as those in any of the first to third embodiments is omitted by assigning the same reference numbers to those in the first, second, or third embodiment. Any explanation of operations and advantages of the fourth embodiment substantially the same as those in any of the first to third embodiments is also omitted for the sake of brevity.

FIG. **13** is a structural diagram showing structure of an image forming apparatus **400** according to the fourth embodiment. The image forming apparatus **400** according to the fourth embodiment has substantially the same structure as the image forming apparatus **300** according to the third embodiment except a detection unit **450**. FIG. **14** is a schematic diagram showing the structures of the belt unit **330** and the detection unit **450**. The belt unit **330** has substantially the same structure as that in the third embodiment.

The detection unit **450** according to fourth embodiment detects, with photo sensors **451** serving as a light amount detection unit arranged in a line extending rearward in FIG. **14**, a detection value for detecting any foreign object on the conveyance belt **331** at a position on a downstream side of the transfer roller **334** in the moving direction of the conveyance belt **331** and on an upstream side of the belt cleaning unit **340** in the moving direction of the conveyance belt **331**. The photo sensors **451** herein are made of reflection type photo sensors, but can be made of transmission type photo sensors.

The control system and the drive system of the image forming apparatus **400** according to the fourth embodiment are substantially the same as those according to the second embodiment. The belt controller **284** shown in FIG. **8** controls the operation of the conveyance belt **331** in lieu of the intermediate transfer belt **131**.

FIGS. **15**A, **15**B are schematic diagrams showing operation of the image forming apparatus **400** according to the fourth embodiment. FIG. **15**A is a schematic diagram showing operation when no foreign object exists. Where no foreign object exists between the belt outside roller **338** and the conveyance belt **331**, reflection rate r detected at the photo sensor **451** is set to a value within a prescribed range as shown by above Formula (3).

In this situation, the whole controller **281** judges the reflection rate r detected with the photo sensor **451** as the normal value. Therefore, the whole controller **281** provides an instruction executing the rotation drive of the drive roller **332** without providing any instruction stopping the printing operation of the belt controller **284**. The belt controller **284**, upon receiving such an instruction, executes rotation drive instruction of the drive roller **332**, thereby rotationally driving the drive roller **332**.

FIG. **15**B is a schematic diagram showing operation when some foreign object **190** exists. Where some foreign object

190 exists between the belt outside roller **338** and the conveyance bell **331**, the reflection rate r detected at the photo sensor **451** takes a value out of a prescribed range likewise above Formula (4), according to the reflection light from the foreign object **190**.

The whole controller **281** therefore judges the reflection rate r detected with the photo sensor **251** as the abnormal value. The whole controller **281** provides an instruction stopping the rotation drive of the drive roller **332** to the belt controller **284**. The belt controller **284**, upon receiving such an instruction, executes rotation stop instruction of the drive roller **332**, and the drive roller **332** stops the rotation drive before the foreign object **190** reaches the belt cleaning unit **340**.

The whole controller **281** may judge as some foreign object exists if the abnormal value is detected at the photo sensors **451** in a prescribed number among the photo sensors **251** arranged in the one line.

Although in the fourth embodiment the foreign object is detected by using the photo sensors **451**, the foreign object may be detected with, e.g., use of a line sensor and image processing. In such a modification, the whole controller **281** may detect the foreign object based on image data given from the line sensor. Although in the fourth embodiment the reflection type photo sensor is used as the photo sensor **451**, if a transmission type photo sensor is used as the photo sensor **251**, transmission rate r is used in lieu of the reflection rate r described above.

Fifth Embodiment

A fifth embodiment is described next. Any explanation of structures in the fifth embodiment substantially the same as those in any of the first to fourth embodiments is omitted by assigning the same reference numbers to those in any of the first to fourth embodiments. Any explanation of operations and advantages of the fifth embodiment substantially the same as those in any of the first to fourth embodiments is also omitted for the sake of brevity.

FIG. **16** is a schematic diagram showing an essential structure of an image forming apparatus **500** according to the fifth embodiment. A paper **502** according to the fifth embodiment is a series of sheets, or namely a web form in a roll shape. In the paper **502**, labels are adhered to a base paper, and images are formed to the labels. The paper **502** is conveyed in a left direction in FIG. **16** by conveyance roller pair **511**. A paper sensor **510** is made of a transmission type sensor formed of a light emission element and a light receiving sensor, or a reflection type sensor detecting reflection intensity, and detects a reference mark formed on the paper **502** or an edge of the label formed with the same interval on the paper **502**. A cutter unit **514** is a rotary type cutter unit, and is a cutting member capable of cutting the paper **502** without stopping the paper **502**. The cutter unit **514** is disposed on an upstream side of the secondary transfer roller **535** described below in the conveyance route of the paper **502**. The cutter unit **514** is controlled to make adjustable a cutting portion based on the detected result of the paper sensor **510** according to the position of the reference mark or the edge of the label.

Another paper sensor **515** is disposed between a conveyance roller pair **512** and a conveyance roller pair **513**. The paper sensor **515** is made of the transmission type sensor or the reflection type sensor in substantially the same way as the paper sensor **510**. The timing of the image formation at the image forming unit **120** is decided based on the detected result of the paper sensor **510** and the paper sensor **515**. It is to be noted that the conveyance roller pairs **511**, **512**, **513** are positioned on an upstream side of the cutter unit **514** in the conveyance route of the paper **502**, and function as upstream side rollers conveying the paper **502** to the cutter unit **514**.

The image forming unit **120** sequentially forms toner images in black, cyan, magenta, and yellow, and transfers the toner images to the intermediate transfer belt **131**. The image forming unit **120** is substantially the same as the image forming unit **120** in the first embodiment. The image forming unit **120** is attached to a top of the belt unit **130**. The belt unit **130** is substantially the same as the belt unit **130** in the first embodiment. The belt cleaning unit **140** and the detection unit **150** are provided in the belt unit **130**. The belt cleaning unit **140** and the detection unit **150** according to the fifth embodiment have substantially the same structures as the belt cleaning unit **140** and the detection unit **150** according to the first embodiment.

The belt unit **130** transfers the toner images formed with the image forming units **120** to the intermediate transfer belt **131**, and further transfers the toner images to the paper **502** supplied from the conveyance roller pair **513**. The toner images transferred to the intermediate transfer belt **131** are transferred to the labels of the paper **502** in application of the prescribed voltage to the secondary transfer roller **535** provided as to oppose the secondary transfer backup roller **136**. The secondary transfer roller **535** functions as a transfer unit transferring the toner images to the paper **502**.

A support bar **516** is arranged above a conveyance route of the paper **502**. An end of the secondary transfer roller **535** and an end of the support bar **516** are rotatably supported at a support frame **517**. FIG. **17** is a perspective view showing the secondary transfer roller **535**, the support bar **516**, and the support frame **517**. As shown in FIG. **17**, the support frame **517** includes a first frame **517***a*, and a second frame **517***b*. The secondary transfer roller **535** and the support bar **516** are disposed between the first frame **517***a* and the second frame **517***b*. A rotary shaft **535***a* of the secondary transfer roller **535** and a rotary shaft **516***a* of the support bar **516** are provided as to extend in parallel to each other, and the first frame **517***a* and the second frame **517***b* support rotatably the rotary shaft **535***a* and the rotary shaft **516***a*, respectively.

The support frame **517** is driven in an up and down direction by drive force from a frame motor **518** (see FIG. **19**) serving as a frame drive unit according to control from a feed and conveyance controller **583** (see FIG. **19**). FIGS. **18**A, **18**B are schematic diagrams showing states that the support frame **517** is moved up and down. FIG. **18**A is a schematic diagram showing a state that the support frame **517** is located at a first portion on an upper side. As shown in FIG. **18**A, where the support frame **517** is placed at the first position, the secondary transfer roller **535** is at a position closely contacting the paper **502** located on an upper side of the secondary transfer roller **535**, and the paper **502** is sandwiched between the secondary transfer roller **535** and the intermediate transfer belt **131**. Where the support frame **517** is at the first portion, the first position can be referred to as the image forming position for forming images because the images are transferred to the paper **502**.

FIG. **18**B is a schematic diagram showing a state that the support frame **517** is located at a second position on a lower side. As shown in FIG. **18**B, the support frame **517** is located at the second position, the secondary transfer roller **535** is at the position not closely contacting and away from the paper **502** below the paper **502**. Where the support frame **517** is at the second position, the paper **502** is separated downward

from the intermediate transfer belt **131** upon pulling down the paper **502** with the support bar **516**. Thus, where the support frame **517** is located at the second position, the paper **502** separates from the secondary transfer roller **535** and the intermediate transfer belt **131**, and because no image is formed, the second position can be referred to as an escaping position at which no image is formed. As described above, where the support frame **517** moves from the first position to the second position, the support bar **516** moves the paper **502** in a direction away from the intermediate transfer belt **131**.

As described above, the secondary transfer roller **535**, the support bar **516**, the support frame **517**, and the frame motor **518** (see FIG. **19**) changing the positions of those members function as a moving unit for moving the paper **502** to a position not contacting the intermediate transfer belt **131** where the controller detects the attachment of the foreign object to the intermediate transfer belt **131**.

A fixing unit **560** shown in FIG. **16** includes inside a halogen lamp **161***a* serving as a heat source, and is made of a roller pair of an upper roller **161** and a lower roller **562** having a respective surface made of an elastic body. The fixing unit **560** melts the toner images in application of the heat and pressure to the toner image on the paper **502**, and fixes the images to the paper **502**. It is to be noted that the operations of the respective parts of the fixing unit **500** are controlled by the fixing controller **185** (see. FIG. **19**) as described below. Subsequently, the paper **502** is conveyed by the delivery roller pair **563** and is delivered to an exterior of an apparatus housing **500***h* of the image forming apparatus **500**. The delivery roller pair **563** is located on a downstream side of the cutter unit **514** in the conveyance route of the paper **502** and functions as a downstream side roller delivering the cut paper **502** to the exterior of the image forming apparatus **500**.

FIG. **19** is a block diagram showing an essential structure of a control system and a drive system of the image forming apparatus **500** according to the fifth embodiment. The control system and the drive system of the image forming apparatus **500** according to the fifth embodiment have substantially the same structures as the control system and the drive system of the image forming apparatus **100** according to the first embodiment except that the controller **580** controls the conveyance roller pairs **511**, **512**, **513**, the delivery roller pair **563**, the cutter unit **514**, the frame motor **518**, and the fixing unit **560**. The controller **580** according to the fifth embodiment has substantially the same structure as the controller **180** in the first embodiment except the whole controller **581**, the feed and conveyance roller controller **583**, and the fixing controller **585**.

The whole controller **581** controls the processing of the entire image forming apparatus **500**. The whole controller **581** performs processing substantially the same as the processing done at the whole controller **181** in the first embodiment and does the control described below. The whole controller **581**, in substantially the same way as the first embodiment, detects some foreign object according to current value from the detection unit **150**. The whole controller **581** provides an instruction to the feed and conveyance controller **583** where some foreign object is detected, thereby stopping the move of the intermediate transfer belt **131**, and moving the support frame **517** downward to render the paper **502** away from the intermediate transfer belt **131**. The whole controller **581** instructs the feed and conveyance controller **583** to render the cutter unit **514** cut the paper **502**, thereby stopping the drive of the conveyance roller pair **511** after the cutting operation, and driving the conveyance roller pairs **512**, **513** and the delivery roller pair **563** to discharge the remaining paper **502** to the exterior of the apparatus housing. The whole controller **581** instructs the feed and conveyance controller **583** to stop the drives of the conveyance roller pairs **512**, **513** and the delivery roller pair **563** after the delivery of the paper **502**.

The feed and conveyance controller **583** controls operations of the various rollers, the lift-up motor **105**, the cutter unit **514**, and the frame motor **518** according to the instructions of the whole controller **581**. The fixing controller **585** controls the fixing unit **560** according to the instruction of the whole controller **581**.

FIG. **20** is a flowchart showing a processing where the whole controller **581** detects some foreign object. In the flowchart shown in FIG. **20**, the processing starts where the whole controller **581** detects some foreign object, or in other words, when the current value from the current amount detection unit **142** takes a value out of the prescribed range.

The whole controller **581** provides an instruction to the belt controller **184** to stop the move of the intermediate transfer belt **131** (Step S**10**). The belt controller **184**, upon receiving such an instruction, stops the move of the intermediate transfer belt **131**.

The whole controller **581** provides an instruction to the feed and conveyance controller **583** to render the paper **502** away from the intermediate transfer belt **131** (Step S**11**). The feed and conveyance controller **583**, upon receiving such an instruction, drives the frame motor **518**, and moves the support frame **517** from the first position to the second position. With this operation, the support bar **516** pushes down the paper **502**, thereby rendering the paper **502** away from the intermediate transfer belt **131**.

The whole controller **581** provides an instruction to the feed and conveyance controller **583** to cut the paper **502** (Step S**12**). The feed and conveyance controller **583**, upon receiving such an instruction, drives the cutter unit **514** based on the detected result of the paper sensor **510**, thereby cutting the paper **502** at the base portion at the interval between the labels.

The whole controller **581** provides an instruction to the feed and conveyance controller **583** to stop the drive of the conveyance roller pair **511** located on the upstream side of the cutter unit **514** in the conveyance route of the paper **502** (Step S**13**). The feed and conveyance controller **583**, upon receiving such an instruction, stops the drive of the conveyance roller pair **511**.

The whole controller **581** provides an instruction to the feed and conveyance controller **583** to maintain the drives of the conveyance roller pairs **512**, **513** and the delivery roller pair **563** located on the downstream side of the cutter unit **514** in the conveyance route of the paper **502**, thereby delivering or discharging the cut paper **502** (Step S**14**).

After delivery of the paper **502**, the whole controller **581** provides an instruction to the feed and conveyance controller **583** to stop the drives of the conveyance roller pairs **512**, **513** and the delivery roller pair **563** located on the downstream side of the cutter unit **514** in the conveyance route of the paper **502** (Step S**15**). The feed and conveyance controller **583**, upon receiving such an instruction, stops the drives of the conveyance roller pairs **512**, **513** and the delivery roller pair **563**.

The whole controller **581** displays information prompting a maintenance check on a display panel of the manipulation unit **171** (Step S**16**). For example, the display panel desirably displays information prompting a maintenance check of the belt unit **130**.

As described above, according to the fifth embodiment, by discharging the remaining paper **502** where the belt unit **130** becomes abnormal, any work to remove the paper **502** remained by the user may become unnecessary, thereby reducing the down or inactive time.

Although in the fifth embodiment described above, the detection unit **150** as set forth in the first embodiment is used, the detection unit **250** as set forth in the second embodiment may be used.

In the first to fifth embodiments as described above, the four image forming units **120** are used, but the number of the image forming units is not limited to this example. For example, solo image forming unit **120** may be provided in the first to fifth embodiments.

The image forming apparatus **100** to **500** according to the first to fifth embodiments described above can be printers, MFPs (Multifunction peripherals), facsimile machines, and photocopiers.

While only selected embodiments have been chosen to illustrate the present invention, it will be apparent to those skilled in the art from this disclosure that various changes and modifications can be made herein without departing from the scope of the invention as defined in the appended claims. Furthermore, the foregoing descriptions of the embodiments according to the present invention are provided for illustration only, and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

What is claimed is:

1. An image forming apparatus comprising:

a movable endless belt;

an image forming unit forming a developer image;

a transfer unit transferring the developer image to a medium on a downstream side of the image forming unit in a moving direction of the belt;

a belt cleaning unit cleaning the belt on a downstream side of the transfer unit in the moving direction of the belt;

a detection unit detecting a surface state of the belt on a downstream side of the transfer unit in the moving direction of the belt and on an upstream side of the belt cleaning unit in the moving direction of the belt; and

a control unit stopping move of the belt where a detected result at the detection unit indicates attachment of any foreign object to the belt.

2. The image forming apparatus according to claim **1**, wherein the control unit stops move of the belt before the foreign object reaches the belt cleaning unit.

3. An image forming apparatus comprising:

a movable endless belt;

an image forming unit forming a developer image;

a transfer unit transferring the developer image to a medium on a downstream side of the image forming unit in a moving direction of the belt;

a belt cleaning unit cleaning the belt on a downstream side of the transfer unit in the moving direction of the belt;

a detection unit detecting a surface state of the belt on a downstream side of the transfer unit in the moving direction of the belt and on an upstream side of the belt cleaning unit in the moving direction of the belt and the detection unit detects a value detecting as to whether any foreign object is attached to a surface of the belt; and

a control unit stopping move of the belt based on a result detected at the detection unit.

4. The image forming apparatus according to claim **3**, wherein the detection unit includes a first terminal, a second terminal, a power source applying a direct current voltage to the first and second terminals, and a current amount detection unit detecting a current value of a current flowing between the first and second terminals,

wherein the first and second terminals are provided as sandwiching the belt, and

wherein any one of the first and second terminals is in contact with the surface of the belt.

5. The image forming apparatus according to claim **4**, wherein the control unit judges as the foreign object is attached to the surface of the belt, where the current value detected at the current amount detection unit is not in a predetermined range.

6. The image forming apparatus according to claim **3**, wherein the detection unit is made of a plurality of photo sensors arranged in a line crossing the move direction of the belt.

7. The image forming apparatus according to claim **6**, wherein the control unit judges as the foreign object is attached to the surface of the belt, where the detected value of the photo sensors in a prescribed number among the plural photo sensors is not in a predetermined range.

8. The image forming apparatus according to claim **1**, further comprising:

a cutting unit disposed on an upstream side of the transfer unit in a conveyance route of the medium for cutting the medium;

an upstream side roller disposed on an upstream side of the cutting unit in the conveyance route of the medium for conveying the medium to the cutting unit; and

a downstream side roller disposed on a downstream side of the cutting unit in the conveyance route of the medium for conveying the medium and delivering the medium to an exterior of an apparatus housing,

wherein the cutting unit cuts the medium, wherein the upstream side roller stops the conveyance of the medium, and wherein the downstream side roller conveys the medium to deliver the medium to the exterior of the apparatus housing.

9. The image forming apparatus according to claim **8**, wherein the belt contacts the medium at a portion that at least the developer image is transferred to the medium, and further comprising a moving unit moving the medium to a position not contacting to the belt at the portion that the developer image is transferred to the medium.

10. The image forming apparatus according to claim **9**, wherein the moving unit comprises a support bar extending in a direction parallel to a longitudinal direction of the transfer unit, a support frame supporting an end of the support bar and an end of the transfer unit, and a frame drive unit moving the support frame to a first position at which the medium contacts the belt and to a second position at which the medium does not contact the belt,

wherein the support bar moves the medium in a direction away from the belt at a time that the support frame moves from the first position to the second position.

11. The image forming apparatus according to claim **10**, and further comprising an indication unit indicating information prompting a maintenance check based on the detected result at the detection unit.

12. The image forming apparatus according to claim **3**, further comprising:

a cutting unit disposed on an upstream side of the transfer unit in a conveyance route of the medium for cutting the medium;

an upstream side roller disposed on an upstream side of the cutting unit in the conveyance route of the medium for conveying the medium to the cutting unit; and

a downstream side roller disposed on a downstream side of the cutting unit in the conveyance route of the medium for conveying the medium and delivering the medium to an exterior of an apparatus housing,

wherein the cutting unit cuts the medium, wherein the upstream side roller stops the conveyance of the medium, and wherein the downstream side roller conveys the medium to deliver the medium to the exterior of the apparatus housing.

13. The image forming apparatus according to claim **12**, wherein the belt contacts the medium at a portion that at least the developer image is transferred to the medium, and further comprising a moving unit moving the medium to a position not contacting to the belt at the portion that the developer image is transferred to the medium.

14. The image forming apparatus according to claim **13**, wherein the moving unit comprises a support bar extending in a direction parallel to a longitudinal direction of the transfer unit, a support frame supporting an end of the support bar and an end of the transfer unit, and a frame drive unit moving the support frame to a first position at which the medium contacts the belt and to a second position at which the medium does not contact the belt,

wherein the support bar moves the medium in a direction away from the belt at a time that the support frame moves from the first position to the second position.

15. The image forming apparatus according to claim **14**, and further comprising an indication unit indicating information prompting a maintenance check based on the detected result at the detection unit.

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